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EXTERNAL REFERENCE

Report**Leak Testing Policy Document**

The scope of this document is to define the roles and responsibilities, methodology and management requirements pertaining to leak testing of vacuum components for use on the ITER project.

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Leak Testing Policy Document (L5P5P2_v2_1)	v2.1	Approved	11 Jun 2014	Updated text with comments from SQS accepted
Leak Testing Policy Document (L5P5P2_v2_0)	v2.0	Approved	26 May 2014	Final Version – replaced “critical” with “key” Slight modification to requirements “nuclear regulator” replaced with “Nuclear Safety Authority”
Leak Testing Policy Document (L5P5P2_v1_2)	v1.2	Signed	19 May 2014	Document updated to reflect comments from review. Policy simplified – no change to requirements or definitions.
Leak Testing Policy Document (L5P5P2_v1_1)	v1.1	Revision Required	24 Apr 2014	Updated as a result of internal review. Once agreed this document will form the basis of the IO leak testing surveillance plan to be developed by PBS 31. It is intended that the leak testing surveillance plan will become part of the MQP documentation to be referenced in system specific surveillance plans.
Leak Testing Policy Document (L5P5P2_v1_0)	v1.0	Signed	24 Oct 2013	

**Document Defining the Requirements and Policy for
Leak Testing ITER Vacuum Components with respect
to Safety and Machine Operations.**

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1 Terms and Acronyms

The terms and acronyms, with contextual meaning, which are used throughout this document, are provided in Table 1.

Term/acronym	Contextual meaning
Key Leak Test	A key leak test is a leak test required to demonstrate that a component or system, can meet the leak rate performance required for plasma operations and that the components, or system, can meet its confinement function with respect to leak tightness
Confinement	Confinement is the term used for the physical enclosure of hazardous substances (e.g. tritium)
DA	Domestic Agency
External Intervener	Entity other than the Operator, or its employees, who supplies a PIC. This includes the DAs, Subcontractors (to either the DAs and/or the Operator) and External Service Providers
External Service Provider	Entity, not the Operator, performing surveillance
FAT	Factory Acceptance Test(s) – test required to demonstrate that the component or system meet its specification and can be accepted for delivery to the IO.
IO	ITER International Organization
MIP	Manufacturing Inspection Plan
Operator	The operator of the basic nuclear facility. In this context the IO is the Operator
PIA	Protection Important Activity – Activity required to qualify the PIC for its safety function (e.g. helium leak test to confirm the confinement function of a vacuum boundary)
PIC	Protection Important Component – Component performing a safety function (e.g. a confinement boundary)
Witness	Observe surveillance of the test being performed

Table 1 Terms and acronyms

2 Scope

The scope of this document is to;

- Outline the requirements pertaining to the leak testing of vacuum components.
- Define key leak tests in the context of the IO.
- Define the IO policy regarding the leak testing of vacuum components for use on the ITER project.

3 Requirements

Vacuum leak testing is required to demonstrate that a component or system, can meet the leak rate performance required for plasma operations and that the components, or system, can meet its confinement function with respect to leak tightness.

3.1 Vacuum Requirements

To meet the vacuum requirements for machine operations the acceptable leak rates through vacuum boundaries are defined in the ITER Project Requirements [1] and specifically in the ITER Vacuum Handbook [2]. By satisfying the leak rate requirements as specified [2] it is implicit that the safety requirement concerning leak rates through a confinement boundary can be satisfied.

3.2 Key Leak Tests

A key leak test is defined as a leak test required in order to demonstrate that a vacuum boundary meets the IO Project Requirements [1].

3.3 Regulatory Requirements

As defined in the Order of 7th February 2012 establishing the general rules for basic nuclear installations [3] components which perform a safety function (e.g. provide confinement) are classified as Protection Important Components (PIC). The Order [3] requires that the safety function of a PIC is qualified by analysis and or test. Vacuum components which, in accordance with the ITER Vacuum Handbook [2], must perform a confinement function are PIC.

Qualification of vacuum a boundary which performs a confinement function is defined under the scope of the Order [3] as a Protection Important Activity (PIA).

Under the scope of the Order [3] the Operator must perform surveillance of a PIA.

The Operator may contract external support for surveillance of a PIA to an external service provider but may have to justify this outsourcing to the Nuclear Safety Authority. This justification shall include the reasons why the surveillance of the PIA is to be outsourced, demonstrating that the operator keeps the responsibility and retains the expertise required to ensure control and include a surveillance plan which details the management of the outsourced task and steps to ensure compliance of the PIA with the Order [3].

All PIA leak tests are deemed key.

4 IO Leak Testing Policy

The following leak tests have been defined as key, surveillance of these leak tests is the responsibility of the IO:-

- Leak tests on vacuum components used to qualify a PIC or a PIA.
- Leak testing as part of the Factory Acceptance Test (FAT) of a vacuum component at External Interveners premises.
- Leak testing on delivery at the IO site of vacuum components in compliance with section 25 of the ITER Vacuum Handbook [2].
- Installation leak testing of vacuum components on integration with ITER systems .

4.1 Leak Tests on Vacuum Components to Qualify a PIC or a PIA

The procedures for these key leak tests shall be developed to show that, on execution, the test will demonstrate the performance of the vacuum boundary with the required sensitivity and that the minimum acceptance leak rate is measurable.

4.2 Leak Testing as part of the Factory Acceptance Test (FAT)

Component vacuum boundaries shall be tested for compliance with the ITER Vacuum Handbook [2] prior to delivery to the IO site.

In the case where the entire vacuum boundary of the component can be qualified with a single leak test, this test shall be deemed key.

In the case where the entire vacuum boundary cannot be qualified with a single key leak test (i.e. the system is not complete) the leak tests that must be performed during manufacture to qualify the vacuum boundary are deemed key.

All key leak tests shall be identified in the component MIP [4] as key. The final acceptance of the component shall only be made by the IO on successful completion of all such tests.

4.3 Installation Leak Testing

All vacuum components shall be the subject of at least one leak test which is deemed key. Key installation leak tests shall be performed at the time of component installation or as part of the system integrated commissioning.

5 Bibliography

[1] Project Requirements (PR) (ITER_D_27ZRW8).

[2] ITER Vacuum Handbook (ITER_D_2EZ9UM).

[3] Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN (ITER_D_7M2YKF).

[4] Requirements for Preparing and Implementing a Manufacturing and Inspection Plan (ITER_D_22MDZD).

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MQP Level 3**Working Instruction for Manufacturing Readiness Review**

This procedure defines the procedural requirements and methods for conducting a Manufacturing Readiness Review (MRR). In this document MRR designates both:

- the period of preparation of the review to the Authorization To Proceed (ATP) to manufacturing
- the review itself which supports the ATP at the end of the period

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Working Instruction for Manufacturing Readiness Review (44SZYP)			
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v1.1	In Work	23 Feb 2011	Minor changes
v1.2	Disapproved	03 Jun 2011	Assigned Reviewers and Approver according to MQP. Added Form of MRR chit and Typical Process of MRR.
v1.3	Signed	26 Jul 2012	- update to comply with MQP Procedure Template - added acronyms list
v1.4	Signed	09 Aug 2012	- update to comply with MQP Procedure Template - added acronyms list
v2.0	Revision Required	08 Feb 2018	Update as per MQP doc Request VQ7WG4. All the document is updated on the latest MQP Documentation Template.
v3.0	Revision Required	09 Apr 2018	Integrated comments from reviewers in particular: - revised section 2: scope: removed reference to Level 2 (not yet approved); clarified scope (limited to manufacturing phase and prior to issue EWP) - revised section 3: definition: removed reference to " installation" - revised section 5: applicable references: rewording for clarifications. In particular relevant to "off-the-shelf" components and design phase status (shall be completed before MRR) - section 7.2.1 (clarification about MRR plan process; to be submitted 6 weeks before (instead of 4) and 7.2.2 (modification/clarification on Panel members with CIO representative added)
v3.1	Approved	11 Jun 2018	This version 3.1 is updated based on comments received from version 3.0 from CIO Deputy Head and from AGN for Design Control Consistency check
v4.0	Approved	18 Nov 2020	As per approved MQP doc Request - 3LGGB, the main changes are: 1/ Update the chapter scope for the case of IO Works Contractor supplied SSCs 2/ Update the chapters 6 Responsibilities and 7.1 Flow chart about the approver of the MRR report (CAT-2093), 3/ update the chapter 7.2.5 Follow up action to specify the tracking of actions (OFI 2 of 2018 MA Internal audit) 4/ update the appendix 1 to integrate the specific PE/NPE requirements (action from 2020 QIA PE/NPE) 5/ update the list of references The draft with tracked changes is attached to the MQP doc Request - 3LGGB.
v5.0	Approved	06 Apr 2021	The doc changed based on the doc request https://user.iter.org/default.aspx?uid=4G5HL7 , but with the changes as provided by author as following: Section 2 – Deletion of text ; “Any manufacturing activities should be authorized by IO supported by the results of a MRR.” Section 2 – “normal” MRR – text replaced by “MRR” Section 5.2 – “Not-critical systems” replaced by “Non-Critical components” – More accurate Section 6 – text modified; “The MRR Chair is responsible to prepare a MRR Report and propose a decision on start/stop work to the DA and IO.” changed to “The MRR Chair in conjunction with the panel members is responsible to prepare a MRR Report and propose a decision on start/stop work to the DA or IO as appropriate.” – Allows flexibility depending on level of control applied Section 6 – 2nd, 5th & 6th bullet points modified to refer “for Critical components where Full / Partial control by IO has been decided for the MRR

			– brings clarity and allows flexibility where no control applied Section 7.1 – text added below flow chart for clarity as follows ; “Note: The workflow above sets out the general steps to be applied to an MRR. Where necessary the above maybe complemented / further developed by a DA to align with their quality needs. The general provisions however shall be respected in terms of roles and responsibilities where IO has Full or Partial Control for component MRRs, unless specific derogation has been granted by the IO.” Section 7.2.3 & 7.2.4 – MRR Chair responsible for report issuance – text updated accordingly Section 7.2.5 – Responsibility for action follow up – text modified to allow flexibility / bring clarity Section 8 (a) – “Panel” changed to “Chair”
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1 Purpose

This procedure defines the procedural requirements and methods for conducting a Manufacturing Readiness Review (MRR).

In this document MRR designates both:

- the period of preparation of the review to the Authorization To Proceed (ATP) to manufacturing;
- the review itself which supports the ATP at the end of the period.

2 Scope

This document is a MQP level 3 procedure and implements the process requirements from section 3.5.1 “Planning” [2] related to “Manufacturing, Assembly and Installation Process” of QAP [1] as a level 3 document.

This document provides requirements and methods to implement MRRs of the ITER components, and if deemed appropriate system or subsystem. These process requirements are applicable to DAs (for in-kind procurements) and Suppliers (for in-cash contracts) and subcontractors who perform manufacturing activities.

In particular, in the frame of the ITER project, the ITER Organization (IO) is responsible towards the French Licensing Authorities for the different Protection Important Components (PIC) and, as such, needs to be involved in the approval of all PIC development phases.

Manufacturing Readiness Review (MRR) is the last review before manufacturing and if successful it gives the “go-ahead” for start the manufacturing of the components as illustrated in the Fig.1.

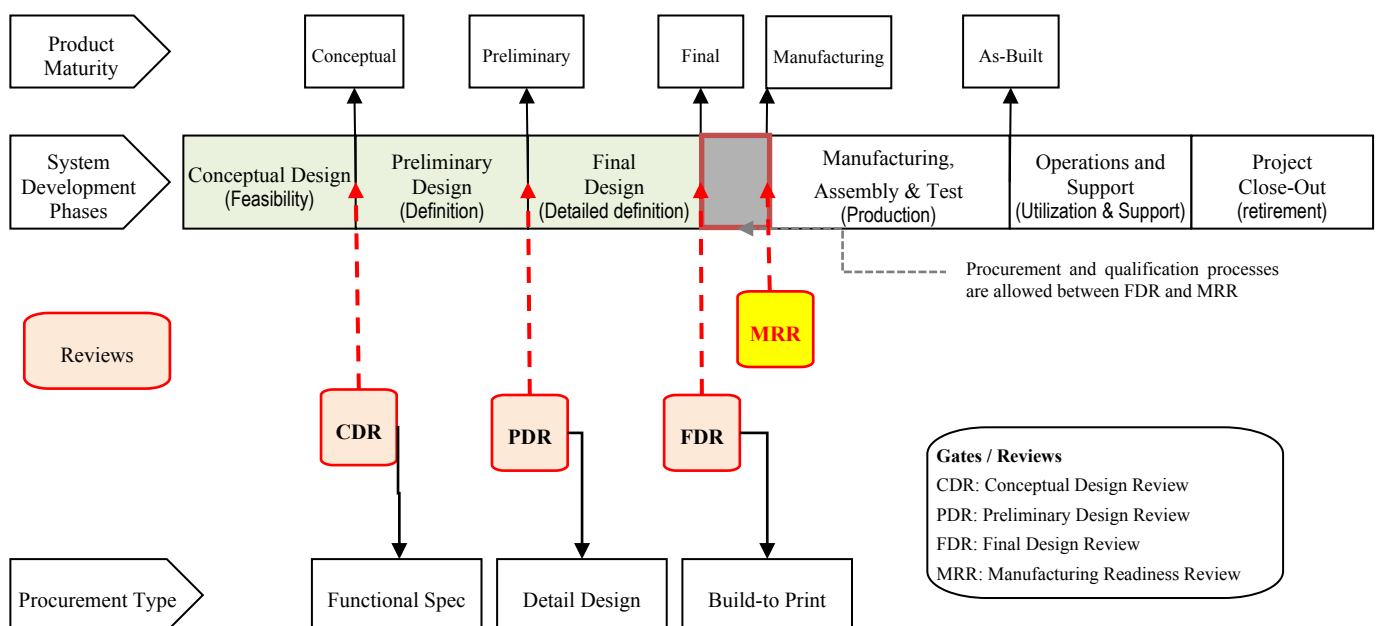


Figure 1 – System life cycle [3]

All MRRs (covering the full Manufacturing scope) should be identified in the IO-Design Review Plan with an indication of their importance (MRR or Simplified MRR), and if it is a Control Point for IO Hold Point (HP) or Authorization To Proceed Point (ATTP).

This procedure describes the general rules for MRRs and specific MRR procedures could be developed by the Project Teams or PBS to better adapt to their specific needs, provided they remain compliant with general provisions from this document including the IO's roles and responsibility.

Process and provision for Manufacturing Readiness Review and Acceptance of Construction Designs execution from BIPS-PT (ref. PBS 61/62/63/65) is covered by [4] and therefore is excluded from the present document.

MRR relates to manufacturing phase/fabrication activities undertaken prior to installation works on the IO site.

MRR can relate to IO DA supplied SSCs or IO Works Contractor supplied SSCs.

In the case of IO Works Contractor supplied SSCs (e.g. fabricated pipework spools intended for installation at the ITER site), the MRR shall be undertaken post issuance of Engineering Work Package (EWP) [5] documentation to IO Construction and review and acceptance / approval of Works Contractor documentation related to the SSCs to be manufactured.

3 Definitions and acronyms

3.1 Definitions

Component: the product to be manufactured as requested in the procurement documentation and that is subject of the MRR. It may be an individual or a group of components of the ITER Facility, and/or parts of components. It includes all requested spare components or parts.

“Delta” MRR: a partial authorization to start Manufacturing up to defined manufacturing operations.

Manufacturing activities: all activities to be performed in order to manufacture the requested component until its delivery on site. These activities are:

- The fabrication including the acquisition and/or fabrication of all raw materials and parts to manufacture the components, and their assembly into the requested component;
- The inspection and testing [6] to be performed on the raw materials, parts and the manufactured component in order to demonstrate the compliance of the manufactured component with its technical criteria;
- The conditioning and packaging of the manufactured component for its storage and shipping to site including its preservation and handling.

Manufacturing activities requirements: a set of technical requirements that has been propagated from the technical criteria of the component to manufacture and that must be satisfied by the manufacturing activities to ensure that:

- The manufactured component meets their technical criteria at delivery on site (fabrication of the component).
- The technical criteria of the component are not impacted during the execution of their manufacturing activities (protection of the component).

Manufacturing/Fabrication: the processes (e.g. by machining, assembly, etc.) of converting raw materials, components, or parts into finished component that meet the technical criteria specifying its manufacturing design.

Manufacturing Readiness Review: a set of verification activities to be performed before the start of manufacturing activities in order to assure:

- The required activities are adequately and ready to be effectively performed according to approved documents;
- The relevant technical criteria of the manufactured component are specified in approved documents including for on-site storage, on-site assembly and installation, maintenance and preservation after installation, commissioning, operation and maintenance;

*It should be noted that through this project gate review, the approved documents which are presented will become **applicable** for the manufacturing phase after acceptance and*

authorization from IO. It is also important to note that even if some approved documents are preliminary version, it will be possible to revise it during the manufacturing process.

Input Data Package: list of documents with their version number, submitted as input to the MRR (ref. Appendix 1)

Procurement documentation: the set of documents transmitted to the manufacturer of the component concerned by the MRR. This set includes:

- For the Domestic Agencies, the Procurement Arrangement Annex A (for project, process and quality assurance requirements), the PA Annex B (for the component technical requirement) and all their applicable documents;
- For IO's direct contractors, the Technical Specifications of the "In Cash Contracts" (ICP), and all their applicable documents;
- For the manufacturers (when different from above), the Technical Specifications of and all their applicable documents has developed by the DA or IO's direct contractors.

Technical criteria: a characteristic of the component to be manufactured that has been fully propagated during the manufacturing design phase completed prior to the MRR.

- Additional propagation or refinement of these requirements is not required regarding the manufacturing design.
- The criteria include, at the minimum, the component identification and number, classifications, dimensions and weights, materials, surface finish/roughness and cleanliness, handling/lifting features, and marking/label. Each characteristic is complemented as applicable with acceptance criteria and acceptable tolerances.
- Only the relevant technical criteria for the successful manufacture of the component are covered by the MRR, that are criteria that:
 - o Will be implemented by the manufacturing activities (fabrication of the component);
 - o May be impacted during the execution of the manufacturing activities (protection of the component).
- The identification of all the relevant technical criteria classified as "Defined Requirements" is mandatory.

3.2 Acronyms

Acronym	Definition
ATP	Authorization To Proceed
ATTP	Authorization To Proceed Point
DA	Domestic Agency
DR	Deviation Request (as defined in [7])
EWP	Engineering Work Package (as defined in [5])
FDR	Final Design Review (as defined in [8])
HP	Hold Point
ICP	In-Cash procurement contract
IO	ITER Organization
MN	Manufacturer Part Number
MRR	Manufacturing Readiness Review
NCR	Non-Conformance Report (as defined in [9])
PBS	Plant Breakdown Structure
PCR	Project Change Request
PIC	Protection Important Component (as defined in [10])
PNI	Part Number of ITER
QADH	Quality Assurance Division Head
QARO	Quality Assurance Responsible Officer
QC	Quality Class (as defined in [11])
QCRO	Quality Control Responsible Officer
PA	Procurement Arrangement
PARO	PA Responsible Officer
TRO	Technical Responsible Officer
SSC	Systems, Structures or Components
VCN	Verification Compliance Matrix

For a complete list of ITER acronyms and abbreviations see [12].

4 Reference Documents

- [1] ITER Quality Assurance Program (QAP) (22K4QX)
- [2] Manufacture, Assembly & Construction Planning Procedure (UYULNL)
- [3] ITER Systems Engineering Management Plan (SEMP) (2F68EX)
- [4] Working instruction for BIPS-PT Manufacturing Readiness Review and Issue of Recommendation for Acceptance of Construction Design by ITER Design Authority (S7HRYX)
- [5] WI for Construction Preparation (EWP/CWP/IWP) (UYGEDA)
- [6] Procedure for Inspection and Testing (TVL3Y5)
- [7] Procedure for the management of Deviation Request (2LZJHB)
- [8] Design Review Procedure (2832CF)
- [9] Procedure for the management of Nonconformities (22F53X)
- [10] Safety Important Functions and Components Classification Criteria and Methodology (347SF3)
- [11] Quality Classification Determination (24VQES)
- [12] ITER D_2MU6W5 - ITER Abbreviations (2MU6W5)
- [13] Procedure for Identification and Controls of Items (U344WG)
- [14] ITER Numbering System for Components and Parts (28QDBS)

- [15] Requirements for Producing an Inspection Plan (22MDZD)
- [16] Work instruction for Producing the Manufacturing & Inspections Plan (UKQG8M)
- [17] PE/NPE - Manufacturing Design Controls for PE/NPE (WSJ6VM)

5 Basic Principles

IO as Final Customer and Nuclear Operator decides the level of control on the MRRs and ATPs, depending on the criticality of the project and as identified in IO-Design Review Plan, as follow:

- Full control: IO organizes the MRR and gives the ATP on the basis of this procedure;
- Partial control: IO gives the ATP on the basis of the results of an MRR organized by the DA or the IO-Contractor, using this procedure or an equivalent procedure (demonstrated by a compliance matrix), submitted to IO's for Acceptance for use before proceeding.
- No IO control: IO leaves the MRR and the ATP organization to the provider (DA or IO-Contractor)

MRR's goal is to enable IO (in the case of ICP) and, IO and DAs (in the case of PAs):

1. To confirm that the manufacture of the concerned component is ready to start without incurring unacceptable risks;
2. To give the authorization to proceed with manufacturing.

Each DA or IO's direct contractors for large/complete ICP contracts shall identify the MRRs to be undertaken taking into consideration the following parameters (not exhaustive):

- Size, number and complexity of the component to be manufactured;
- Number of manufacturers used for the PA and ICP contract;
- The graded approach defined by IO, the DA and/or direct contractor.

The outcome of this activity is:

- The number of MRR to be performed per PA/ICP;
- For each MRR, the concerned component(s) and manufacturer(s);
- Target dates for MRR.

A typical process for the preparation and execution of a MRR is shown in the Flow Chart Section 7.

A MRR shall only be executed after:

- the completion of the design phase of the concerned component, including the development of the manufacturing design with the appropriate integration of information from the selected manufacturer;
- the acceptance of the manufacturing design;
- the approval and authorization for use of all the documentation that constitute the Input Data Package for the MRR (see Appendix 1);
- all resources needed to proceed with manufacturing confirmed as are available.

A MRR shall be performed before fabrication starts and after the completion of the qualification phase unless otherwise agreed between IO and DA (in the case of PAs)

The MRR shall review the documents of the Input Data Package in order to verify that the appropriate manufacturing activity requirements have been defined in order to ensure that:

- The technical criteria of the component to be manufactured are not impacted during the execution of their manufacturing activities;
- The manufactured component meets its technical criteria at delivery on site.

It shall verify that all manufacturing activities have been planned and prepared to ensure that the work can be accomplished as specified.

The MRR shall also check that:

- Identification of components and parts will be achieved in consistence with MQP identification procedures [13], [14] during manufacturing
- Preservation has been studied (packing, packaging , handling, protection on site procedures)
- specific procedures and specifications have been prepared to define the installation conditions and tooling as well as maintenance and preservation and spares need after installation

These studies (identification, preservation, installation, maintenance) shall be achieved by the manufacturer with the support of its customer (DA or IO)

In particular the following general points shall be verified during a MRR:

- (a) check appropriateness of area and working facilities;
- (b) check availability of materials and ‘off-the-shelf’ datasheets to start work and their compliance to applicable specification and with appropriate traceability;
- (c) check availability and approved status of the relevant drawings, including required tolerances, to start work and their compliance to applicable specification;
- (d) check availability and approved status of applicable quality and manufacturing documentation (e.g. Quality Plan, Manufacturing Inspection Plans, Non-destructive testing protocols, Welding data package, Process qualification records, etc.)
- (e) check availability and appropriateness of machine & tooling and the approval status of manufacturing procedure compliant with manufacturing process qualifications as may be applicable;
- (f) check availability and appropriateness of personnel in term of qualifications and number, as may be applicable;
- (g) verify by direct evaluation of manufacturing process, facilities, and personnel whether manufacturer has capability to ensure quality of product within required schedule;

- (h) verify approval status of all documents and records as appropriate, (e.g. manufacturing procedures, qualification report/certificate, etc.) confirming that manufacturing processes conform to specified (PA or ICP) requirements;
- (i) check all documents and records are designated properly with contract / job number, concerned product number, etc.
- (j) check availability and use of applicable documentation including standards and codes;
- (k) verify by examination of plans and documents whether a suitable QA/QC program has been developed to ensure production monitoring;
- (l) check configuration status including NCR and Deviations and Design changes status which should be closed;
- (m) check the requirements propagation by VCM fulfilment as specified in 5.1.6
- (n) Verify the identification of:
 - (i) All the manufacturing activities classified as Protection Important Activity, with their Defined Requirements and imposed Technical Controls and criteria/tolerances.
 - (ii) All the relevant technical criteria classified as Defined Requirements.
- (o) check of subcontracted operations.

Objective is to:

- (i) verify approval status of the manufacturing documentation (ref. Annex 1);
- (ii) verify approval status of the preservation documentation (packing, packaging, on-site storage, on site protections);
- (iii) verify approval status of installation and maintenance documentation
- (iv) making sure that all requirements are considered and that VCM is fulfilled with evidences
- (v) approve or reject the start of manufacturing.

The MRR needs to take into account the graded approach, so that the products that are considered Critical for the ITER project (e.g. the system contains component PIC and/or QC1 or QC2; components or systems that have a relevant financial impact/cost; products that have a complex manufacturing process and involve the different specialities and special processes; Pressure Equipment and/or Nuclear Pressure Equipment) are given high priority.

The necessity and decision on MRR application shall be established during the contract's preparation (PA's or ICP as applicable) with the definition of Control Points. In case of 'off-

the-shelf components’’ (e.g. raw materials already available from the market / commercial item from manufacturer’s catalogue) derogation from MRR execution could be accepted as specified in the relevant contract.

In case a system is not considered Critical (e.g. it does not contains PIC component or QC1 or QC2) implementation of a “simplified MRR” could be agreed with IO as described in Subsection 5.2.

All MRR meetings shall be conducted in a formal way. The comments from the reviewers shall be recorded and related actions shall be tracked.

In case of any need of change detected during an MRR and depending by criticality of impact of this change on design requirements a DR or a PCR shall be issued.

Note: In case of possible issues identified during the MRR the manufacturing shall be “ON HOLD” or may be partially authorized highlighting any outstanding obligation.

In some cases MRRs may be split (“Delta” MRR) in time for schedule optimization due to phased manufacturing. In this case the criteria above could be applied to the partial MRRs.

5.1 MRR General Content

The MRR shall cover:

5.1.1 *Material*

- Manufacturing environmental conditions meet product technical requirements (e.g. temperature, humidity, cleanliness class, ventilation, segregation from other material, etc.).
- Production materials used for ITER project are correctly procured, qualified, inspected and stored. Compliance with contractual requirement is confirmed and all material (raw, finish goods, nonconforming product, etc.) are well controlled in production line.
- Appropriate procedure/system for assuring material identification and traceability.
- All products designed for manufacturing shall be designated with type reference codes, i.e. PNI and/or MN.

5.1.2 *Personnel*

- Personnel who work for ITER project have been trained and evidence that IO requirements, as imposed through the contract documents, are understood is available. Personnel are qualified as may be applicable. In particular the qualified operators for special process (e.g. welding, heat treatment, NDE) are available and sufficient number of resource is allocated.

5.1.3 *Machines and Tools*

- Machines, jigs, measuring and testing equipment used for IO are qualified and valid for usage, e.g. the equipment list is in place, the maintenance plan is established, the calibration is kept valid, etc.
- Processes: specific manufacturing processes (e.g. heat treatment, welding, coating, cleaning, bending, forming, etc.) have been qualified as may be applicable.

5.1.4 *Manufacturing methods*

- Check documents relevant to ITER project are approved or accepted by IO as may be applicable (e.g. Quality Plan, the MIPs, manufacturing procedures, the work instructions, manufacturing drawings, etc. including all changes affecting the system).
- Check documents stating compliance of manufacturing processes, facilities and personnel (including applicable approval and qualifications) and whether manufacturer has capability to ensure quality of product within required schedule.

5.1.5 *Transportation and ITER site activities*

- Check documents describing packing, packaging, transportation, handling and protection on ITER site
- Check relevant documents detailing installation and maintenance on ITER site and particularly specific tooling and spares when needed.
- Check Planned Delivery List describing all items or groups of items to be delivered. Where all items listed in the list designated with PNI's and/or MN.

This specific part of the studies are performed by the IO TRO in case of ICP or DA coordinator in case of PA with the manufacturer inputs

5.1.6 *Requirements*

- A specific matrix is built for the component to manufacture (DA coordinator or IO TRO) with all the requirements and the evidences coming from the previous design review (FDR) – that is the Verification Compliance Matrix (VCM)
- Check additional technical criteria generated by the manufacturer studies
- Check ITER site activities requirements (preservation, installation, maintenance)
- Check evidences provided by the manufacturer to fulfil all the requirements

All these verification may be done by documentary review and check and/or through on-site verification at manufacturer's premises as may be more appropriate. Adequate traceability and record shall be ensured.

5.2 **Simplified MRR**

In case of Non-Critical components (e.g. non-PIC component or QC1 or QC2), a "Simplified MRR" process, with no meeting but only review of documents, could be agreed with the IO:

- MRR Responsible party (DA in case of PA or Contractor in case of ICP) shall issue an MRR Plan containing the List of document of the input data package and a detailed checklist of elements to be checked.
- Needed elements are requested from and provided by the Manufacturer.
- DA coordinator and/or IO TRO review the elements described in the MRR Plan and issue final MRR report to give ‘go-ahead’ or stop decision.

6 Responsibilities

DA in case of PA or the contractor/supplier in case of IO direct contract is responsible for preparation, implementation, and follow-up action of MRR.

IO and DA in case of PA or IO in case of ICP shall select MRR panel members on key MRR identified by IO and designate a chair and a secretary for each of those MRR.

The MRR Chair in conjunction with the panel members is responsible to prepare a MRR Report and propose a decision on start/stop work to the DA or IO as appropriate.

The Manufacturer shall provide all requested information and evidences as requested by the MRR panel and described in MRR plan in order to evaluate and confirm manufacturer readiness including manufacturing area/facilities, machine/tooling, personnel, material, procedure approval status and manufacturing and process qualifications as may be applicable. In particular the Manufacturer shall provide a detailed manufacturing scheduling and approved inspection plan [15].

IO shall be responsible for controlling and supporting DA’s or Supplier/Contractor MRR.

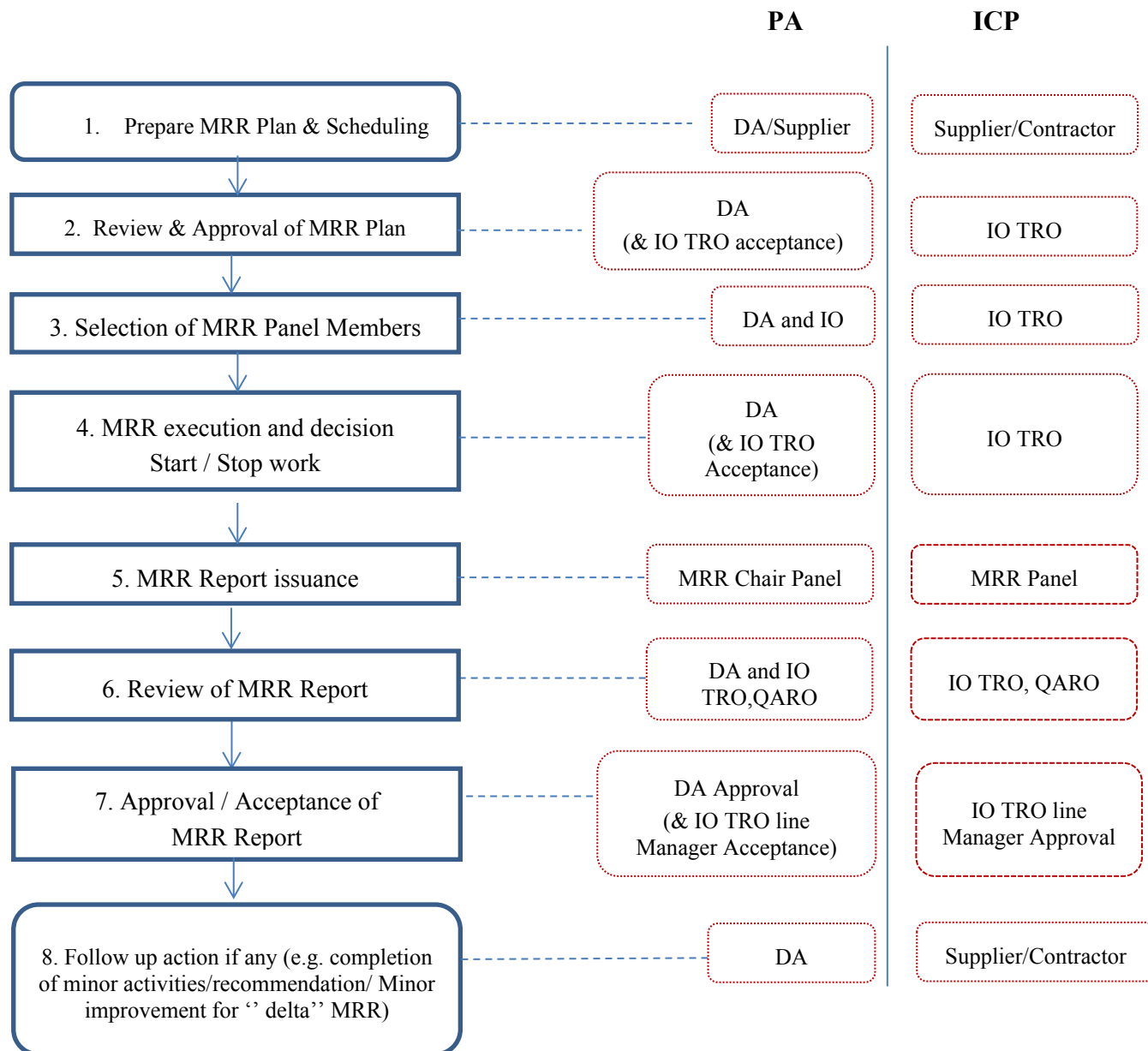
In particular, IO TRO shall:

- Participate in MRR meetings for PIC, Quality Class1, and Quality Class 2 SSCs.
- Review the MRR Plan and MRR Report for Critical components where Full / Partial control by IO has been decided for the MRR
- Be involved in preservation, installation, maintenance studies
- Check the VCM to ensure that all requirements are propagated with related evidences
- The IO QARO should be involved in the review of the MRR plan for Critical components where Full / Partial control by IO has been decided for the MRR and shall review MRR Report to verify adequacy of quality requirements.
- The IO TRO line Manager (e.g. Division Head or Section Leader) shall accept / approve the MRR Report for Critical components where Full / Partial control by IO has been decided for the MRR

7 WORKFLOW

7.1 Flow chart

The MRR workflow is presented below splitting responsible in case of PA and in case of ICP.



Note: The workflow above sets out the general steps to be applied to an MRR. Where necessary the above maybe complemented / further developed by a DA to align with their quality needs. The general provisions however shall be respected in terms of roles and responsibilities where IO has Full or Partial Control for component MRRs, unless specific derogation has been granted by the IO.

7.2 Description

Main steps for MRR implementation as listed in the workflow are described here below:

7.2.1 MRR Plan and scheduling

In the frame of MRR plan preparation or before, the MRR responsible party (the DA or the supplier/contractor) should perform a visit to the manufacturer facilities and subcontractor's facilities whereas appropriate (e.g. execution of critical operations) in order to verify the manufacturing work area, materials traceability, equipment's and machines, personnel qualifications and resources availability are suitable to accomplish the work in accordance with the applicable requirements.

Prior to performing a MRR, the MRR responsible party, in conjunction with IO, shall prepare a MRR Plan that identifies:

- scope (list of PBS) of the MRR with applicable PA and/or contract documents
- list of equipment in the scope
- MRR panel members and their roles and responsibilities
- Qualification of the Chair
- sub-supplier organization involved in the MRR
- Input data Package: list of documents and items needed to be assessed
- schedule of the MRR
- previous MRR details, if applicable

A MRR pre-meeting may be held by DA, IO and suppliers (for in cash contracts) to prepare the MRR outline or to review adequacy and effectiveness of the proposed MRR Plan.

MRR responsible party shall submit the completed MRR Plan to IO for acceptance at least 6 weeks before the MRR scheduled date.

IO shall review the MRR Plan and provide written comments, if any, to MRR responsible party for resolution and agreement with IO before MRR execution.

Upon IO acceptance of the MRR plan, involved organizations and MRR Panel members shall be notified at least 2 weeks before the MRR is conducted. This notification should be in writing and include information such as the scope and schedule of the MRR, MRR Panel members and complete set of documents to be assessed.

If it is found that a scheduled MRR date cannot be met after the approval of MRR plan, upon written request from DA TRO or Contractor Responsible as may be applicable, IO TRO may authorize a reasonable extension.

7.2.2 *Selection of MRR panel members*

The MRR panel consists of a Chair and selected experts.

MRR Panel Chair shall be a technical and managerial qualified person who is in charge for:

- a) Approve the charge for the review by the TRO
- b) Propose name of members for the review panel
- c) Approve the meeting(s) agenda
- d) Ensure that participants understand what is required to them
- e) Ensure that sufficient time is allocated for review activities
- f) ensure that the meeting's input package is issued to designated persons;
- g) assign tasks to participants in preparation for meetings;
- h) chair the review meeting, moderate the discussions ensuring that the focus stays on the manufacturing readiness assessment and that all attendees may provide their input and try to reach consensus in the review team in case of differences of opinion. If consensus cannot be reached, forward minority as well as majority view(s) for decision in the Manufacturing Readiness Review Panel Report;
- i) ensure that relevant issues from the meeting are recorded;
- j) ensure that actions and recommendations from earlier meetings have been satisfactorily addressed and closed, as appropriate;
- k) review and approve the minutes of meeting;
- l) ensure that the minutes of meeting are issued to all participants.
- m) coordinate the development of Manufacturing Readiness Review Panel Report with the Panel members and approve the report.

In addition to the Chairperson, appointed members should be QARO, SRO, CIO and CST representative and experts as may be proposed by DA, where applicable, and agreed by IO in accordance with the scope of the review. In case of PAs the IO TRO shall be part of the MRR Panel.

The MRR panel members shall be selected considering the type of system or component to be reviewed, its safety and quality classification, and the manufacturing techniques to be used. While selecting MRR Panel members, a special knowledge, prior experience, and education shall be considered. The nature of the MRR may require the assistance of technical specialists. If so, specialists shall be involved in the MRR.

For MRR on PIC, QC1, and QC2 SSCs, the Chair and the Panel shall be independent from the manufacturing design development i.e. not belonging to the Manufacturer's organization.

7.2.3 MRR execution

The MRR panel shall conduct the MRR under the direction of the Chair and in accordance with the approved MRR Plan:

- Prior to starting the MRR, each panel member shall develop a clear understanding of the scope of the MRR, the reliability aspects of the work scope, the requirements and rules applicable to the work to be reviewed, and the communication and reporting agreements made with the organization responsible for performing the work.
- Checklist shall be used and completed. However, a checklist should not preclude the opportunity to verify manufacturing readiness which may have the potential to yield problem. Nor should the checklist prevent the immediate follow-up of an important or significant concern.

IO external expert may participate in MRR for PIC, QC1, and QC2 SSCs. The responsibility for IO external expert is to audit/oversee the process and not to give any Authorization To Proceed.

If any significant conditions adverse to quality are identified, the Chair shall immediately notify to IO TRO of that condition by telephone and/or e-mail. IO TRO shall consult with IO QADH and the appropriate managers as may be the case (e.g. Depending on the pending issue: CST for site activities; CIO for integration and requirements propagation; TED and PED for condition related to the design; etc.)

Results of the MRR shall be documented on the checklist by MRR panel, if applicable.

At the end of the MRR, a time slot should be allocated for the Chairman to debrief MRR meeting's outcome to responsible managers of the applicable organizations and inform if the MRR is successful meaning that nothing is preventing the ATP to be given.

It is IO to give ATP in case of IO Control Point.

Upon the completion of the MRR, DA in conjunction with MRR panel members shall summarize the MRR results in a formal Manufacturing Readiness Review Panel Report.

The Manufacturing Readiness Review Panel Report shall contain the following

- scope of the MRR with applicable PA and/or contract documents;
- MRR panel members;
- Input data Package;
- summary of MRR results and action items to be taken and schedule, if applicable;
- completed checklists;
- appraisal of the review by the Chair, and recommendations for ATP.

MRR Chair shall forward the completed and approved MRR Panel Report to IO TRO for acceptance. The Acceptance of the MRR Panel report constitutes the "Authorization To Proceed".

IO is in charge for review and acceptance of the MRR Report as follows:

- IO TRO and any other assigned reviewer (e.g. IO QARO, IO SRO) shall review the report and IO TRO shall accept the Report or reject it notifying his comments.
- The report shall be distributed to applicable organizations within IO for information.

7.2.4 MRR conclusion and final report

Scope of MRR is to confirm or not authorization to start manufacturing.

The MRR Chair (supported by the Panel) shall issue a formal report including recommendations to be carried out along with a clear recommendation on the following possible outcomes:

- (i) Successful: there is no objection to deliver the ATP (manufacturing can start).
- (ii) Unsuccessful: manufacturing start shall be placed “ On HOLD” until resolution of detected major issues. MRR shall be repeated once available evidences of resolution of detected major issues.
- (iii) Conditionally Successful upon the completion of certain minor activities by the Manufacturer in order to comply with a specific recommendation.
- (iv) Start of manufacturing activities should neither be stopped nor held unless a major issue is detected. A partial authorization to start could be provided (up to defined manufacturing operation) and a “Delta” MRR could be considered at a later date in order to give the opportunity to the Manufacturer to improve the maturity of the manufacturing documentation (any contractual impacts are out of scope of this document) and resolve minor issue, if any.
- (v) After due consideration of the MRR conclusions, the IO TRO shall decide the start or otherwise of the manufacturing activities. In case of discrepancy between the IO TRO decision and the MRR conclusions, the IO TRO decision shall be endorsed by the IO QARO and by his/her direct line of management.

7.2.5 Follow-up Action

Prior to the start manufacturing, DA and/or Contractors in case of direct contracts as may be applicable shall resolve unacceptable quality conditions or lack of preservation, installation, and maintenance activities description, resulting from the review. A chit list shall be issued in this case to ensure follow up and closing of all findings. Fabrication shall not start before relevant MRR requested actions are closed, unless otherwise agreed by the DA/IO as applicable depending on the Level Of Control applied to the MRR, e.g. differently authorized by the IO TRO following the process described in Sect. 7.2.4 (v).

A graded approach needs to be used for documenting the open actions after the MRR. DA and/or Contractor shall notify the DA / IO TRO of status of follow-up actions on a periodic basis. The DA / IO TRO shall ensure follow up through periodic progress meetings. For Critical components the IO TRO shall be notified in all cases.

8 Outputs and Records

(a) The MRR Chair is responsible for issuing a MRR Panel Report with a clear recommendation on the outcome of the review.

(b) The IO TRO is responsible for notifying the MRR Panel and all concerned functions (e.g. Project Team; Technical Process Integration, etc.) on the final decision taken and for archiving all review records in accordance with project procedures including the charge, the Review Panel composition, attendees, presentation material, Review Panel reports, approvals to proceed, and declarations of review closure.

NCR, Actions, Checklist and MRR Plan and report shall be recorded in IDM in accordance with relevant process and defined tools.

Type of output	Format	Location of output	Document type	Instructions for identification of the output	Responsible for managing the output	Retention period
<i>MRR Report</i>	<i>Template</i>	<i>IDM PA/ICP folder</i>	<i>“R – Report, record, Certificate” - MRR Report</i>	<i>MRR Report</i>	<i>IO TRO</i>	<i>Project Life</i>

ANNEX 1 – MRR Input Data Package

The checklists to be used for MRR shall be prepared consistently with importance and complexity of items to be manufactured and may take into account guidance provided in this Annex.

MRR input data package shall include management documents like the following (as a guideline because some documents can be grouped):

- Manufacturing Implementation Plan (covering description points at section 5.1)
- MRR Plan,
- Notification,
- Agenda,
- Presentation,
- Minutes of MRR meeting (record of what has happened during the meeting),
- Panel Report (comments and decisions)

In addition, list of document of the input data package shall be provided. Applicable documents, namely for instance procedure documents, welding documents, Codes, & Standards, tooling related documents, certificate of personnel should be submitted as attachments of Manufacturing Plans.

All documents should be uploaded in IDM (or PLM) or any other agreed tool allowing for review prior to a review meeting, with attendance from IO, DA and Suppliers as may be applicable. All the required documents shall be accepted by IO before manufacturing can commence.

In the frame of PA, the MRR list may be elaborated upon mutual agreement between the DA and the IO and included as part of the review. DA may request MRR Panel members to initiate the checklist relevant to their expert discipline.

Document list below is provided as general guide for required documents to be provided in Data Package for a MRR. This list has to be discussed in the frame of MRR plan review. The list provided here below does not intend to be complete and not all types of documents need to be provided for each MRR depending on item to be reviewed:

1. Engineering	
1.1	List of Deviation Requests if applicable
1.2	Manufacturing drawings (2D) and models (3D) *
1.3	Assembly drawings at the shop *
1.4	Assembly drawings at the ITER site as may be applicable (e.g. for installation) *
1.5	Parts and Material list, list of equipment and detailed Bill of material (if necessary)*
1.6	List of standards, codes and regulations applicable for each step of manufacturing, assembly and integration
1.7	Item Identification & tagging and physical labelling procedure
1.8	Top assembly description and function
1.9	Load analysis as part of the manufacturing process (if necessary)
1.10	Design description and justification of transportation frames
1.11	List of deliverables to be provided by the Manufacturer / Manufacturer Dossier content
1.12	Verification Compliance Matrix (requirements and evidences)
2.Manufacturing processes	
2.1	Manufacturing and Inspection Plan
2.2	Manufacturing schedule and work flow/assembly sequences
2.3	Material procurement technical specification and sub-orders (including e.g. consumables whereas applicable)
2.4	Material management: - identification and control of material - material certificates - material traceability procedure - Storage conditions - Handling procedures
2.5	Manufacturing procedures including special processes (e.g. machining, forming, wiring, brazing, soldering, welding, cleaning, heat treating, others and non-destructive examination, etc.). E.g.: - components processing and assembly specification - cleanliness program - surface treatment program - pipeline inspection program - non-destructive testing program - labelling program (can be included into the tagging & labelling procedure) - coating program - preservation, packaging, storage and transportation program
2.6	Manufacturing working instructions

2.7	Welding data package - Welding procedures/welding Procedure Specification (WPS) - Welding procedure qualification record (WPQR) - Welding quality inspection and procedure plan (WQIPP) - Welding map - Cleaning procedure and requirements for welded parts / components with particular attention on welded joints forming parts of the vacuum boundary according to requirements of ITER Vacuum Handbook.
3.Test methods	
3.1	Control specifications, Testing plan and Test procedures (e.g. Pressure Test Procedure; Helium Leak test procedure; etc.)
3.2	Qualification through Mock-ups and prototype
3.3	Qualification of special processes
3.4	Manufacturing process qualification procedure
3.5	Manufacturing human resources and quality control procedure
3.6	NDE procedures and templates
3.7	Factory acceptance test program identifying all factory acceptance tests as defined at design stage and including details on extent of the tests, type, examinations and inspections of the Items (verification of requirements for acceptance stage)
4.Quality acceptance	
4.1	Quality Plan
4.2	List of Suppliers/Subcontractors and their attributions
4.3	DA, Suppliers and Sub-contractors Quality Plans
4.4	Agreed/Notified Bodies approvals or other third party (where applicable)
4.5	MRR deliverables list (list of documents deliverables to be provided by the Manufacturer)
4.6	Other applicable and/or available documents relevant to manufacturing quality acceptance
5.Tooling	
5.1	List of machines, test equipment and tools including relevant calibration protocols: - the calibration status and records of the machines and tools - Measuring and test equipment qualification and maintenance - Requirements regarding special tooling / spares and any special pieces of equipment or tools needed for packaging, handling, storage, transportation and installation at ITER site.
6.Training and qualification	
6.1	- list of personnel qualifications to perform a special process as may be applicable - list of qualified welders, welding equipment operators, NDE personnel - training records and certificates
7.Transportation and preservation	
7.1	- Packing and packaging procedure - On site preservation procedure - planned delivery list *
8.Installation and Maintenance	

8.1	- Installation and User manual including tooling - Maintenance plan
9. ITER Manufacturer of PE / NPE	
9.1	When ITER acts as Manufacturer of PE/NPE, in accordance with “<i>Implementation Plan for design and manufacture of PE/NPE (VE2DSP)</i>” for the MRR IO shall provide documents demonstrating that the manufacturing design of the equipment fit for use and comply with all requirements (called Equipment Design Review). Exhaustive list of documents constituting this Equipment Design Review are defined in chapter 5 of [17].

* items inside list and drawings shall be properly tagged according to [14] .

INSPECTION PLAN					
Document Number:				Revision Number:	
ITER Procurement Arrangement Number:		ITER Contract Number:		Title of Item / Identification:	
Name of DA/Supplier:				Name of Supplier/Subcontractor:	
Prepared by (Name & signature) Position: Date:		Approved by DA (Name & signature) Position: Date:		ITER IO QA Acceptance (Name & Signature) Position: Date:	Code* HP: Hold Point NP: Notification Point W: Witness of Operation S1: 100% Inspection S2: Random Inspection R: Review Report

Operations (Manufacture, Inspections & Tests, etc.)(2)	Expected Date	Applicable procedures, drawings, instructions, etc	Inspection Body				Records (report, non- conformance number, etc)	Observation(s)
			Supplier	DA	ITER IO	Others ⁽¹⁾		
			Name, Sign & Date	Name, Sign & Date	Name, Sign & Date	Name, Sign & Date		
1				*	*	*		
2								
3								
4								
...								

(1) Others: Third Party Inspection Organization (TPI) or Agreed Notified Body (ANB) or French Safety Authority (ASN), etc. shall be identified

(2) If the operation is a Protection Important Activity (PIA), this PIA shall be identified and a technical control shall be defined.

[Code]

- Hold Point (HP): Identifies an operation that must be signed off by an IO representative before work proceeds beyond this point.
- Authorization to Proceed Point (ATPP): Identifies an operation that must be signed off by a DA representative before work proceeds beyond this point.
- Notification Point (NP): Identifies an operation that must be notified to an IO/DA representative. This notification gives the IO/DA representative the opportunity to arrange an inspection visit if deemed necessary therefore adequate notice must be given to permit arrangements for this visit. In the absence of the appointed representative and with IO/DA documented agreement work can proceed.
- Witness (W): identifies an operation that must be witnessed.
- Surveillance (S1): identifies an operation that requires 100% inspection.
- Surveillance (S2): identifies an operation that requires random inspection or spot checks.
- Review (R): identifies a document or report that must be reviewed.
- Where R/W is used for Radiography, this means that actual radiographs must be checked as well as the reports

[How to fill out the form]

- Operations (Manufacture, Inspections & Tests, etc.): List of operations in sequence expected.
- Expected date: An approximation of the date when an operation is scheduled (estimated month).
- Applicable procedures, drawings, instructions etc: All documents giving reference requirements and acceptance criteria which will be used for the designated operation, such as Welding Procedure Specifications, Welding Plans, Welding Inspection Record Sheets, NDE Procedures, Pressure/Leak Test procedures, etc.
- Identify any other organization employed to perform inspection activities.
- Records (report, non-conform. Number, etc.): Documented products issued during the operation. It is also recommended to include identification number of documentation.
- Observation(s): Any special issues or clarifications raised during inspection for reference or information.



IDM UID

4CK4MT

VERSION CREATED ON / VERSION / STATUS

07 Jan 2025 / 4.1 / Approved

EXTERNAL REFERENCE / VERSION

MQP Level 3**ITER System Design Process (SDP) Working Instruction**

The System Design Process-Working Instruction (SDP-WI) provides guidelines to the System -ROs for the planning of their documents during the design development phases and up to Manufacturing Readiness Review (MRR).

<i>Approval Process</i>			
	<i>Name</i>	<i>Action</i>	<i>Affiliation</i>
<i>Author</i>	Lebourgeois T.	07 Jan 2025:signed	IO/DG/ESD/DO/ICAS
<i>Co-Authors</i>			
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#drn#

Change Log			
ITER System Design Process (SDP) Working Instruction (4CK4MT)			
Version	Latest Status	Issue Date	Description of Change
v0.0	In Work	21 Apr 2011	
v1.0	Approved	05 Jul 2011	First version
v2.0	In Work	02 Oct 2019	As per approved MQP doc request https://user.iter.org/default.aspx?uid=X45X3C the changes are: - Aligned with Technical Document Families and covered documents (TDFC). - Better integrated within the Design Control document structure. - Added Manufacturing Design and Preparation phase documents.
v2.1	Approved	04 Oct 2019	Technical change: update of the document numbers in the tables 1 and 2
v3.0	In Work	11 Sep 2020	As per approved MQP doc request https://user.iter.org/?uid=3JH453 there are no changes to the document but this review is to have DAs in the loop for impact assessment and make the documents Annex A PA AD through the MPA.
v3.1	In Work	01 Dec 2020	As per approved MQP doc request https://user.iter.org/?uid=3YWWSB the changes are: - Table 9: 2 documents merged (Engineering Analysis and Calculation Report), some clarification - Appendix 3: link to the new document containing the former Appendix 3.
v3.2	Revision Required	03 Dec 2020	Corrected bad pdf formatting in Appendix 2
v3.3	Approved	08 Mar 2021	Main changes made to address previous version comments: - Completed and improved few definitions (architecture, part definitions) - Added references to BOM and Identification of items procedures - Aligned with the new SIRO's role Please refer the attached track change version for changes made.
v4.0	Revision Required	20 Dec 2024	As per CWH2TR and further communication the changes are: -update as per IO Re-org -update due to changes of ICP document types in 2023 (TDF -> TDT) -update to align with other MQP Procedures (Design Review Procedure, L2 Design Control Procedures, SEMP..)
v4.1	Approved	07 Jan 2025	- Chapter 7.1: correction of RACI information for Design Integration Reviews - Appendix 1: clarification of requirements regarding CMM during Final Design

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1 Purpose

The **System Design Process**-Working Instruction (SDP-WI) provides guidelines to the System¹-ROs for the planning of their documents during the design development phases and up to Manufacturing Readiness Review (MRR).

During these phase activities, the Design Development process covers the production of engineering deliverables describing and demonstrating the functionality and performance of the system model. It covers also the plans, instructions and procedures controlling the –abilities (manufacturability, assembly and installation-ability, testing and commissioning-ability, operability, maintainability, disposability of the system...) after the MRR until the end of the system product lifecycle.

The detailed description and maturity content of all engineering deliverables [Generic Document Titles -GDTs] and their procedures can be found in the Technical Document Types Cards (TDTC) [R7].

Note that in case of conflict the SDP-WI content has precedence over the TDTCs content.

The selection of each technical document shall be tailored to the complexity of the system, its criticality (e.g. according to their quality class [R9] or safety classes [R10] or to the maturity of involved technology), and the already achieved design development stage.

2 Scope

The SDP-WI shall be applied by any System-RO for preparation of the Conceptual Design, Preliminary Design, Final Design and Manufacturing Design phases.

This set of documents is defined at System level but as recommended by the Systems Engineering approach, each lower PBS node should also be defined by same document-types (i.e. sub-SRD, sub-Design Description (DDD), sub-Justification documents should be created at sub-system level, and so on...), down to the lowest Configuration Item [R2].

Note 1: The process is generic enough to be understood and tailored for any discipline (mechanical, electrical, I&C, etc...). Depending on the discipline deliverables may be called using a different terminology but should always correspond to a certain TDT/GDTs.

¹ See Definitions

3 Definitions and acronyms

3.1 Definitions

Term and definition
Configuration Management (CM) Relevance A document is CM relevant at a given gate when it is a reference against which the product(s) of any following phase is/are verified. The document is placed under Configuration Control (i.e. part of the Technical Baseline) after the gate closure. An update of such document will require a PCR.
Configuration Item (CI) A basic unit of Configuration Management (CM) for which a relevant authority exists and decides to control its definition as well as to closely monitor its changes. CIs may vary widely in complexity, size and type and may represent an entire system, a subset of it, or a component.
Component An ITER Component is a major piece of equipment uniquely located within an ITER System, such as a pump or a tank, which is tagged with a Functional Reference (FR).
Design Justification Document: Document that supports the justification of a design solution, i.e. documents providing evidence that the requirements in the technical requirement specification are satisfied.
Design Solution: Set of documents which describes the Functional and Physical Architecture of the considered SSC and which drives the realization, operation and maintenance, disposal of equipment satisfying the requirements as indicated in the technical requirement specification.
Function: A task to be performed by the system to achieve a required outcome or satisfy an operational need. Functions are captured in the context of performance requirements. (NB: not to be mixed with performance baseline)
Generic Doc Title (GDT): Name of each type of technical document, defined as outputs of MQP procedures and organised in Technical Document Types (TDT).
Manufacturing Design (MD): Set of Detailed Design documents produced by the Manufacturer which provides confidence in the Manufacturer's capability to satisfy Client's Procurement Specification. MD content is detailed in Appendix 1 of Working Instruction for Manufacturing Readiness Review (44SZYP). MD is an input to the shop floor and/or procurement work and does not therefore necessarily include detailed fabrication methods (<i>fabrication sequences, task lists and shop floor travellers</i>) used by the machine operators to implement MD's fabrication requirements.

Margin / Contingency

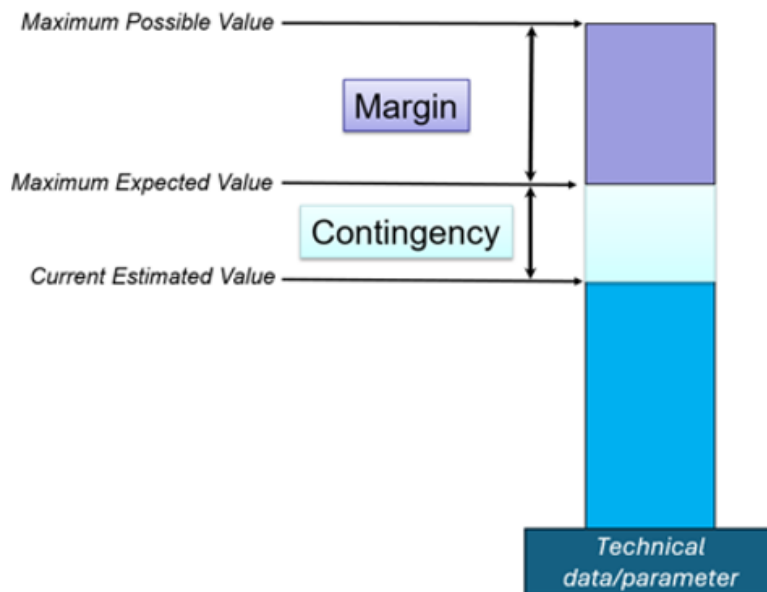
Margin is the difference between the maximum possible value and the maximum expected value.

Contingency is the difference between the current estimated value and the maximum expected value.

Current estimated value: it is the value of the technical data/parameter known at date

Maximum expected value: it is the most extreme value of the technical data/parameter that the design team expects will be observed as the design is refined and become more mature. It is based on the return of experience of the design teams.

Maximum possible value: it is the maximum expected value increased by the margin. It acts as a buffer to provide “design place” for a less mature design and to account for uncertainties.



Part: a single item which generally cannot be further disassembled.

System: A set of components which interact according to a design so as to perform a specific (active) function, in which an element of the system can be another system, called a subsystem.

NOTE: At ITER, “system” sometimes designates the top-level ITER systems, corresponding to PBS Level 1 or sometimes level 2 and which have a toplevel SRD (System Requirement Documents), also called Configuration Items Level 1. Currently around 90 “systems” are defined to cover the ITER Facility

The lower-level systems are called sub-systems and have dedicated sub-SRD (sub-System Requirement Document), also called Configuration Items Level 2.

System-RO: The System Responsible Officer (SysRO) is in charge of the full life cycle of the system. It is by default the Project Leader of the delivered system. Project Leader (SysRO) may nominate staff(s) for SysRO duties with associated responsibilities and authorities to one or more employees of the ITER Organization who have the competence necessary to accomplish the tasks under her/his OBS. Outside Project Leader OBS, CPL can nominate staff for those roles in collaboration with the Project Leader (SysRO).

Technical Document: Any container of (technical) information which:

- gives information about the technical aspects and technical management of system and enabling systems for each lifecycle phase,
- is subject to versioning and applicability, as well as to a given workflow towards approval (this is also valid for drawings, schematics and 3D data),
- and can be easily allocated to one of the Technical Document Type (TDT) & to one GDT.

3.2 Acronyms

See also [ITER Abbreviations 2MU6W5](#)

ATP	Authorisation-to-Proceed
CI	Configuration Item
CIC	Controls & Integrated Commissioning Program
CIDH	Central Integration Division Head
CM	Configuration Management
CMM	Configuration Management Model
COTS	Commercial Off-The-Shelf
CWP	Construction Work Package
DA	Domestic Agency
DCM	Design Compliance Matrix
DDD	System Design Description Document
DECO	Design Coordinator (from Design Office)
DIR	Design Integration Review
DIRO	Design Integration RO
DP	Design Plan
DPP	Document Production Plan
FAR	Functional Analysis Report
FBS	Functional Breakdown Structure
FS	Functional Specification
GDT	Generic Document Title
HAZOP	Hazard and Operability Study
HIRA	Hazard Identification and Risk Assessment
ICD	Interface Control Document
IS	Interface Sheet
PA	Procurement Arrangement
PBS	Product Breakdown Structure
PCR	Project Change Request
PE/NPE	Pressurized Equipment/Nuclear Pressurized Equipment
PIC	Protection Importance Component
PM	Program Manager
PR	Project Requirements
QARO	Quality Assurance Responsible Officer
RO	Responsible Officer
ROX	Return Of Experience (also REX)
RPM	Requirement Propagation Matrix
RQ	Requirement
RQM-RO	Requirement Responsible Officer
SIRO	System Integration RO
SOA	Sign-Off Authority
SDP	Systems Design Process
SDR	System Design Review

SEMP	Systems Engineering Management Plan
SIS SL	System Integration Section Leader
SLS	System Load Specification
SRD	System Requirement Document
SRO	Safety Responsible Officer
SSC	System Structure and Component
s-SRD	Sub- System Requirement Document (Children of an SRD)
TDT(C)	Technical Document Type (Card)
VCM	Verification Compliance Matrix

4 Reference Documents

- [R1] [ITER Systems Engineering Management Plan - ITER-SEMP \(2F68EX\)](#)
- [R2] [ITER Configuration Management Implementation Plan \(CMIP\) \(27LHHE\)](#)
- [R3] [Sign-Off Authority for Project Documents \(2EXFXU\)](#)
- [R4] [Design Planning Procedure \(U34ACR\)](#)
- [R5] [Design Input Control Procedure \(U34CSG\)](#)
- [R6] [Design Development Procedure \(U34DDZ\)](#)
- [R7] [Technical Document Types \(TDT\) Cards \(BFF8H7\)](#) (folder)
- [R8] [Design Interface Control Procedure \(28VNJG\)](#)
- [R9] [Quality Classification Determination \(24VQES\)](#)
- [R10] [Safety Important Functions and Components Classification Criteria and Methodology \(347SF3\)](#)
- [R11] [Data supplied by the IO operator to NPE manufacturer \(VHBYMG\)](#)
- [R12] [Design Review Procedure \(2832CF\)](#)
- [R13] [Implementation plan for design & manufacture of PE/NPE \(VE2DSP\)](#)
- [R14] [PE/NPE - Manufacturing Design Controls for PE/NPE \(WSJ6VM\)](#)
- [R15] [Procedure for Identification and Controls of Items \(U344WG\)](#)
- [R16] [Work Instruction for Creation of Part Number of ITER, PNI and Cataloguing \(UYGU3S\)](#)
- [R17] [Work Instruction for Generation of ITER Bill of Materials \(BOM\) \(VXMR6K\)](#)
- [R18] [Yearly Design Review Plans \(UZ9ZJG\)](#)
- [R19] [ITER Procedure for Performing Hazard and Operability \(2F5L5M\)](#)
- [R20] [Identification of Occupational Health & Safety Requirements related to Design \(TME48W\)](#)
- [R21] [Project Requirements \(PR\) \(27ZRW8\)](#)
- [R22] [Project Change Procedure \(22F4E5\)](#)
- [R23] [Design Integration Review Procedure \(3CNWMT\)](#)

5 Basic principles

5.1 Roles for System Design Development

Generic roles established in [Design Input Control Procedure](#) [R5] and [Design Development Procedure](#) [R6] are transposed at System level the following way:

1. Design Coordinator:

The Design Coordinator is the person responsible for the execution of the System design and the execution of the SDRs

2. Design Developer:

The **Developer** of the **System Design** is the technical person who supports the Design Coordinator to produce the System Design Documentation.

3. Design Approver:

The Design Approver is the duly authorized person to approve the system design on behalf of his/her organization. Within the IO, the System Design Approver is the Program Manager of the related system.

5.2 Context

The [ITER Systems Engineering Management Plan - ITER-SEMP](#) [R1] define the systems engineering technical phases (Conceptual Design, Preliminary Design...), and the main objectives of each technical phases. During each technical phase, a set of technical documents (system requirements, design description, justification...) shall be developed to help maturing the design.

The **main objectives, inputs and outputs** of the design phases (Conceptual Design, Preliminary Design, Final Design and Manufacturing Design) are detailed in **Appendix 1**.

5.3 Preparation for System Design Development

The Design Development process is applied during each design phase, and the output controlled through ‘phase reviews gates’ [R1].

In each design phase, the Design Development process is applied recursively (progressively down the PBS levels) and till the required document maturity as detailed in this document is achieved.

5.3.1 Design planning

Each design phase starts with the definition/update of the Design Plan (DP) for the management of the phase and the identification of the documents (DPP) to be produced or refined during the phase.

Below is reminded the set of input for the System Design Development (*output of the System Design Plan [R4]*):

<u>Description</u>	<u>Main Documents</u>	<u>Complementary documents (*)</u>	<u>Doc.# (Table 9)</u>
Plan Activity	System Design Plan (DP)		7.1
Plan Deliverables		System Document Production Plan (DPP)	N.A.

(*) documents included in or separate from main document but referenced in it

Table 1 – Inputs from Design planning

5.3.2 Design Development Input Requirements

Below is reminded the set of design input requirements (*outputs of the System Design Input Control process [R5]*):

<u>Description</u>	<u>Main Documents</u>	<u>Complementary documents</u>	<u>Doc.# (Table 9)</u>
Specify System Requirements	System Requirement Document		1.1
		ICD/IS	1.2/1.3
		CMM	1.4
		ITER Load Specification	1.5
		ITER Concept of Operations	5.1

Table 2 – Inputs for Design Development

Note: Design input requirements for the other design phases include the baseline documents validated after the previous Design Reviews.

6 Process application during each design phase

The System Design Development process comprises 3 sub-activities [R6]:

1. Develop Architecture Definition (Physical & Functional)
2. Perform analyses and calculations (to support functional and physical decomposition, optimization of the architectures, trade-off analyses and to verify the preferred solution)
3. Specify the System Design Solution.

The System Design Development process is applied in each design phase as detailed **on Figure 1**.

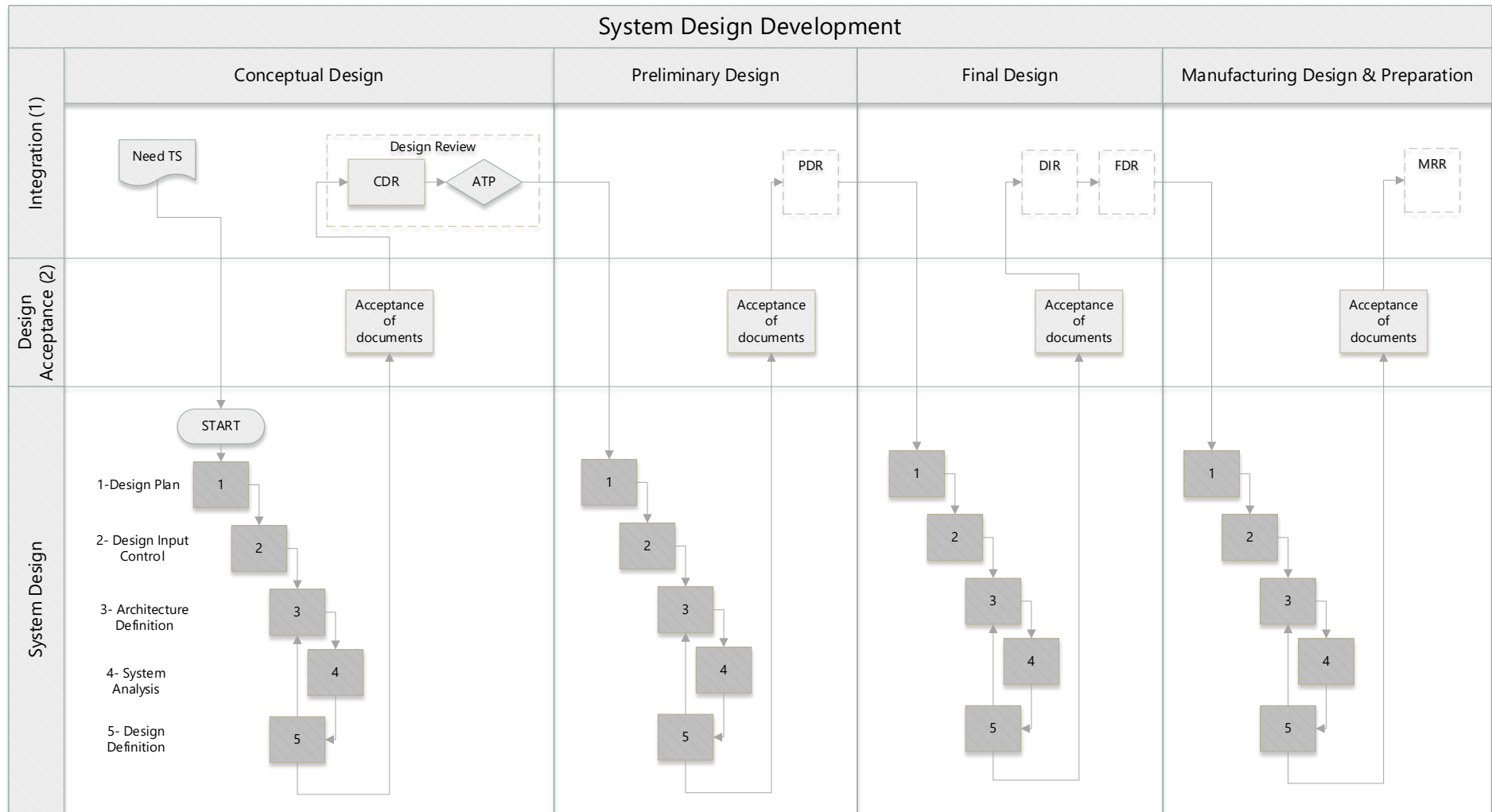


Figure 1: Process application during design activity phases

(1): Design Integration Review, Interface Review and System Design Review

(2): In case of Procurement

Note: The System Functional Solution Definition process [R6] is first applied in the Conceptual Design to decompose the System Functions down to the level necessary to identify a lower-level function which can be achieved by a feasible SSC. A feasible SSC is either an SSC existing on the market (Catalogues- Commercial Off-The-Shelf components - COTS) or an SSC which can be reasonably fabricated based on the Design Developer's experience (Return Of Experience - ROX).

In the Preliminary and Final Design, the System Functional Solution Definition process is applied at lower levels of the product to refine the sub-system and component design up to the component level (Detailed Design with Component Technical Specification).

For a system in development, most technical data/parameters carry both margin and contingency. Generally speaking, the current maximal of a data/parameter change as the design of the system matures, and the margins and contingencies can be reduced as the design of the system reaches the Final Design Stage.

NB: Hidden margins shall be excluded to avoid stacking conservatisms that could lead to over costs and potential non feasibilities (exceeding the technical or regulatory constraints).

Once documents and documents maturity (also called "passing gate" criteria) are achieved for a given gate review, the System-RO shall organize (or make it organized) a System Design Review [R12] or an MRR for validation and authorization for use of the design package, according to the ITER Design Review Plan [R18] and Configuration Management Implementation Plan-CMIP [R2].

Note: A Review of Interfaces and/or a Design Integration Review (DIR) is/are organized before the FDR to check the correct development of Interfaces and/or the Integration of the Design in its environment.

6.1 Conceptual Design

The System-RO shall apply the Design Development process (Figure 1) for the objectives defined on **Table 5** in Appendix 2 and produce design documents for "Conceptual Design" maturity as detailed in the summary **Table 9** in Appendix 2.

During Conceptual Design, focus is finalisation of requirements, Functional analysis and search for solutions for the higher levels of the PBS (system, sub-system, up to critical components) and demonstrate feasibility of the system.

6.2 Preliminary Design

The System-RO shall apply the Design Development process (Figure 1) for the objectives defined on **Table 6** in Appendix 2 and produce design documents for "Preliminary Design" maturity as detailed in the summary **Table 9** in Appendix 2.

6.3 Final Design

The System-RO shall apply the Design Development process (Figure 1) for the objectives defined on **Table 7** in Appendix 2 and produce documents for "Final Design" maturity as detailed in the summary **Table 9** in Appendix 2.

6.4 Manufacturing Design

The System-RO shall apply the Design Development process (Figure 1) for the objectives defined on **Table 8** in Appendix 2 and produce documents for “Manufacturing Design” maturity as detailed in the summary **Table 9** in Appendix 2.

Note: When IO is acting as manufacturer, the design of PE/NPE is developed during the manufacturing design phase. See [R13] and [R14].

7 Responsibilities

7.1 System Design developed internally

The SDP-WI is implemented using the RACI matrix below:

Description	RO (Doer /writer)	Accountable (Approver)	Consulted (Contributor/ Reviewer)	Informed (User)
Generate SRD	SIRO & System-RO	Design Approver	SRO, Design Coordinator, Transverse Functions RO	RQM-RO
Develop Interfaces documents	SIRO & System-RO	SIS SL	Interfacing Systems (1)	
Develop System Design documents incl. Verification	Design Developer	Design Approver or delegate	SIRO, DIRO, SRO, QARO, DECO, Discipline Expert	
Organize Design Integration Review	DIRO (or SIRO if solely functional)	DIS SL	Design Team and other IO Stakeholders (see [R23])	
Organize System Design Review	Design Developer	Design Coordinator	IO Stakeholders (see [R1])	Interfacing Systems
Authorization To Proceed after Design Review close-out.	Design Developer	CID Head	Design Approver, Design Coordinator, SIRO, CIC Program Manager	

(1) When the interfacing system is procured by a DA/Contractor, DA/Contractor TRO shall be reviewer [R8]

Table 3 -RACI matrix for internal design

For the full detail of Sign-off of each design output, please refer to Project SOA [R3].

7.2 System Design developed through Procurement

The design development work (specified in a procured work package) for a given activity phase may be executed by other design development teams in other Organizations (Domestic Agencies-DA or IO Contractors). In that case the work is formalized through a procurement scheme (IO-direct contract or a Procurement Arrangement) signed by both parties.

During the procurement activities, performed mainly at sub-system level or below, the monitoring of the procured work is delegated to an IO-PA-TRO or an IO-Contract-TRO (who may be also the IO-System RO).

When preparing the design procurement scheme the IO-PA-TRO/ IO-Contract-TRO should ensure that the planning of the work and list of deliverables is compliant with the IO's rules.

During execution of the procured design activities, the IO-PA-TRO implements a Surveillance Plan and produces documentation related to the monitoring of the activities, review and acceptance/approval of deliverables according to approved procedures. He/she shall ensure the consistency and propagation of the System RQs to all the lower-level specifications and the compliance of delivered design with the RQs identified in the Procurement Technical Specification.

Appendix 1: Design Activity Phases: inputs, outputs and objectives

A- Conceptual Design (CON)

Conceptual Design Activity Phase	
Phase Inputs	- Inputs from upper level: - Technical rules to be followed (codes & standards, handbooks, etc.) - Allocations of Requirements to the systems (via SRDs) with relevant physical envelopes/space reservations (CMMs) and interface design specifications (ICDs) and preliminary PBS tree - Workplan (Design Plan/DPP for the Conceptual Design Activity phase). The plan shall clearly define the scope (system i.e. Configuration Item Level 1 or Level 2) and the boundaries.
Main Objectives	- To produce the documents for the considered system (Configuration Item) and maturity relevant for the Conceptual Design Activity phase as indicated in the Design Plan. - To consolidate design inputs and interfaces: - Finalisation of the systems requirements (SRDs), including reference to all complimentary applicable documents (handbooks...) - Boundaries of the system have been established, interfaces are properly and exhaustively identified through Interface Control Documents (ICD); ICD shall contain the work plan to specify all interface requirements (in IS) at the different interface points. In addition, allocation for main balances shall be defined with services systems and interfaces with more developed systems shall be defined with a sufficient detail level to avoid delay of their design. - Physical interfaces requirements: CMMs of systems [mainly for Building Integration] - To outline at least one feasible design solution: - Description of the proposed concept solution and its functioning (functional diagrams) - Identification and localisation of main components (system layout drawing / 3D models) - To identify via the Design Compliance Matrix (DCM) which: - Requirements have already been considered in the Design (and those which were not for risk assessment) - Design options are assessed in terms of risks and the selected design solutions/options are justified and supported by necessary analyses - To identify impact of non-achievable requirements (draft PCR), with:

	○ Identification of modifications needed to SRD ○ Identification & assessment of impacts on Overall project requirements (PR) [R21].
Phase Outputs (Maturity Level)	• As a result of the Conceptual Design Activity phase: The system requirements are complete and the system is deemed feasible. The System Design Definition shall meet the requirements and is achievable at an acceptable risk and cost. • SRD, Interfaces and CMM are developed, • Functional Specifications (for FS PAs) and outline drawings of sub-systems are available with their traceability matrices to SRD (RPM, DCM). • System Architecture and system decomposition is prepared. • This Phase is terminated with the approval of the Close-out Report of the Conceptual Design Review (CDR), giving the Authorisation-to-Proceed (ATP) to the next activity phase (Preliminary Design).
Notes	<i>Non-achievable requirements may be accepted provided that their impact has been assessed, the change to the SRD identified and the impacts of the system requirements on the overall project assessed, as per PCR procedure [R22].</i>

Table 5 – Conceptual Design Activity Phase: inputs, outputs and objectives

B- Preliminary Design (PRE)

Preliminary Design Activity Phase	
Phase Inputs	- Consolidated Technical/Engineering data (system + Plant levels) produced by all systems during the CON phase - Workplan (Design Plan and DPP for the Preliminary Design Activity phase). The plan shall clearly define the scope (system i.e. Configuration Item Level 1 or Level 2) and the boundaries, especially if the scope is smaller than previous phase (Conceptual design).
Main Objectives	- To produce the documents for the considered system (PBS node) scope and maturity relevant for the Preliminary Design Activity phase as indicated in the Design plan. - At the beginning of the Preliminary Design Activity phase, to select a design option if various solutions were defined during Conceptual Design - To refine the Conceptual Design to confirm the technical feasibility and the robustness of selected design solution, considering costs and schedule constraints. Evidence is given in: - An update of the Design Description (DDD), considering carefully margins and contingencies. - Functional Diagrams (P&ID, SLD, I&C architecture, etc) - An update of the physical representation of the system - An update of the System Load Specification, - An update of the definition justification documents, referring to a first consistent set of justification notes demonstrating that the technical objectives of the systems requirements will be met (analyses, return of experience, tests, simulations) and that manufacturability, on-site delivery (for High Exceptional Loads), assembly/installation and start-up and maintenance of the system have been addressed - To allocate system requirements to the subsystems (e.g. in s-SRD) to comply with the general architecture of the system. - To fully define Interface requirement specifications that are necessary to perform, or that have an impact, on the Final Design activities (exhaustive and with appropriate maturity). An Interface Requirement defines the functional and physical requirements and constraints that exist at a common boundary between two SSC. The Interface Requirements are recorded in Interface sheets. - To plan the future steps of justification in a consistent way (in particular all the tests on mock-ups/prototype for design qualification/verification should be planned in Verification/Qualification Plan) - To re-assess the technical risks of the selected solution and provide mitigation plan before going to the detailed design (Risk/Hazard Analysis Report) [R19] [R20]. - To check that the proposed design solution definition still meets the RQs (DCM for SRD/s-SRD)

Phase Outputs (Maturity Level)	System Design with the preliminary design maturity: • General architecture (Functional: FBS, Physical PBS-GBS) is consolidated and the main (or critical) components described adequately NB: Level of details in the Design of PBS elements varies with each system or component depending on the level of risk (mature/COTS or to-be-developed technology) • All the Interface Requirements shall be fully defined. • 3D model / System Layout Drawing • System Load Specification is consolidated • Justification documentation, including verification plan are prepared ➤ This Phase is closed with the approval of the Close-out Report of the Preliminary Design Review (PDR), giving the Authorisation-to-Proceed (ATP) to the next activity phase (Final Design).
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Table 6 – Preliminary Design Activity Phase: inputs, outputs and objectives

C - Final Design (FIN)

Final Design Activity Phase	
Phase inputs	• Technical/Engineering data produced during the PRE phase • Workplan (Design Plan and DPP for the Final Design Activity phase). The plan shall clearly define the scope (system i.e. Configuration Item Level 1 or Level 2) and the boundaries, especially if the scope is smaller than previous phase (Preliminary design).
Main Objectives	• To produce the documents for the considered system (PBS node) scope and maturity relevant for the Final Design Activity phase as indicated in the Design Plan. • To refine the design to a level where the final definition of the product (PBS element) is sufficiently complete to allow starting the manufacturing design & preparation phase (subsystem/component specifications are detailed enough to be “understandable” by the manufacturer). • To update all ICD/IS according to refined design definition • To have a complete and approved CMM (under config branch) • To build a complete set of justifications demonstrating that: ○ Component specifications and design are justified (supporting analyses, return of experience, tests and explanations) ○ The specification of the qualification process is fixed (test objectives, logical sequencing, expected results, etc.) • To develop documentation covering the following aspects of the system: manufacturability, on-site delivery, assembly/installation, commissioning, operation and maintenance of the system
Phase Outputs (Maturity Level)	• Complete definition of the system (DDD, diagrams, 3D models (DM/CM), drawings, component lists, etc) • Detailed definition of the composing PBS elements (i.e. Functional References) ready for manufacturing/detailed design. • Full set of justification documents (including DCM, Structural Integrity Reports, etc) • Plans for next phases (manufacturing, installation, commissioning, operation and maintenance) ➤ This Phase is closed with the approval of the Close-out Report of the Final Design Review (FDR), giving the Authorisation-to-Proceed (ATP) to the next activity phase (Manufacturing Design and Preparation).
Note	<i>When IO is the manufacturer of the PE/NPE to be designed, as part of the Final Design process, IO acting as Operator shall establish PE/NPE specific documents [R11].</i>

Table 7 – Final Design Activity Phase: inputs, outputs and objectives

D - Manufacturing Design & Preparation

Manufacturing Design & Preparation Activity Phase	
Phase inputs	- Detailed definition of the composing PBS elements (Functional References) ready for manufacture studies, - Workplan (Design Plan and DPP for the Manufacturing Design and Preparation Activity phase). The plan shall clearly define the scope (system i.e. Configuration Item Level 1 or Level 2) and the boundaries, especially if the scope is smaller than previous phase (Final design).
Main Objectives	- To produce the documents for the considered scope and maturity relevant for the Manufacturing Design and Preparation Activity phase as indicated in the Design Plan. - To refine the design definition (Manufacturing Design) to a detailed level for the workshop execution (manufacturing drawings, fabrication, factory acceptance tests, data sheet for COTS, Manufacturing and Controls procedures, Weld Plan, tooling, trainings, materials certificates, tagging procedure) - To generate Manufacturing-Bill of Materials (M-BOM) [R17] and deliverable list. - To generate Manufacturing Implementation Plan (MIP). - To build a complete set of justifications demonstrating that: - Manufacturing design is compliant with the Manufacturing requirements (Compliance Matrices - VCM), - Manufacturing Design is justified (supporting analyses, return of experience, tests and explanations), - Component Qualification is finalised (in particular for PIC) - Manufacturing processes are qualified
Phase Outputs (Maturity Level)	Manufacturing design: - Manufacturing Inspection Plan - Detailed definition of the composing products/equipment's and their identification following [R15] [R16], ready for procurement (for COTS) or actual fabrication. - Detailed definition of the welded joints (welding maps...) - Material certificates - Manufacturing Procedures, NDT procedures, tagging procedures - Factory Acceptance Test Plan and procedures, - Qualified manufacturing, coating and assembly processes and tools - Qualification of operators Requirements for the preservation of the product and its qualification over the product lifecycle. ➤ This Phase is closed with the approval of the Close-out Report of the Manufacturing Readiness Review (MRR), giving the Authorisation-to-Proceed (ATP) to the next activity phase (Manufacturing).
Note	<i>According to Implementation Plan [R13] and procedure [R14], when IO acts as manufacturer of PE/NPE it performs</i> <i>a PE/NPE Technical Review of the inputs supplied by IO operator prior to the manufacturing design</i> <i>and a PE/NPE Technical Review of the outputs of the manufacturing design.</i>

Table 8 – Manufacturing Design & Preparation Activity Phase: inputs, outputs and objectives

Appendix 2: Summary of the System Design Documents and maturity at gates (Table 9)

Table 9 gives the design documents to be typically developed or updated during the system design development phase up to MRR.

The details of these documents are given in **Appendix 3** and can also be found in [R7].

This documentation covers all the design development (definition, justification) of the system itself but also:

- design management documents (which control the production of design development documents),
- documents defining the input requirements,
- documents (implementation plans and procedures) which control the implementation of the design solution during the future phases of production or utilization of the system products.
- documents linked to the procurement activity.

The list shows for each gate the maturity level (or passing gate criteria) of the documents:

☒ : Not Required
 PL: PreLiminary
 CS: ConSolidated
 CP: ComPlete
 UD: UpDate of CP if needed
 IfU: If Useful
 S: At any Stage

Note 1: This list gives the main documents to be developed. It is expected that in addition to the cited documents the System-RO opens the TDTC / related MQP procedures and assesses which GDT should be produced as output of his/her work.

Note 2: This list is applicable for all systems, whatever the engineering discipline (mechanical, electrical, building, process, I&C, etc.). Some documents are specific to discipline work, they are not all indicated here and should be prepared according to the discipline's templates (codes, handbooks, guidelines etc...) shown in the TDTCs.

Note 3: Depending on the complexity of the system and the criticality of the discipline to be treated, it may be agreed that certain documents with preliminary status are replaced by a Section in the DDD,

Note 4: The reference documents and their relevant sections should be used extensively in the text of technical documents to avoid duplication and maintenance of information.

Appendix 2: Summary of the System Design Documents and maturity at gate (Table 9)

Doc. #	[Design Aspect] and System Design Documents	Procedure /Guideline	CDR	PDR	FDR	MRR	ICP Doc Types	TDTC UID
1.	Design Requirements							
1.1	System Requirements Document (SRD or Sub SRD) (1)	25DSU2	CP	UD	UD		System Requirements Document-SRD	BXPZJS
							Sub-System Requirements Document-sSRD	BXQ4VC
1.2	Interface Control Document (ICD)	28VNJG	CP	UD	UD		Interface Control Document-ICD	BZVDCD
1.3	Interface Sheet (IS)		PL	CS	CP		Interface Sheet-IS	BZKUP3
1.4	Configuration Management Model-CMM	V2ERKH	PL	CS	CP	If U	Not Applicable	WA46NH
1.5	System Load Specification	22MAL7	PL	CS	CP		Load Specification	WBBFYH
	Design Description							
1.6	System Design Description (DDD)	2M24AM	PL	CS	CP		System Design Description-DD	BXQ6H5
1.7	System Layout Drawing	See TDTC	PL	CS	CP		System Layout Drawing	WA9HY6
1.8	Building Drawing	See TDTC	PL	CS	CP	UD	Site & Building Drawing	W9ZKZY
1.9	Process Flow Diagram (PFD)	T7GQGS	CP	UD	UD		Process Flow Diagram-PFD	BK6T9E
1.10	Piping and Instrumentation Diagram (P&ID)			PL	CP		Piping and Instrumentation Diagram-PID	C7Z4TS
1.11	Single Line Diagram (SLD)		PL	CP	UD		Single Line Diagram	C7Z3TJ
1.12	Cabling Diagram-CBD			PL	CP	UD	Cabling Diagram-CBD	C7YW7M
1.13	Detailed Wiring Diagram-WD				PL	CP	Detailed Wiring Diagram-WD	BK6V8E
1.14	Instrumentation and Control Document (PCDH Deliverables) (2)	27LH2V		PL	CS	CP	Instrumentation and Control Document	C94MZN
1.15	Instrumentation and Control - Physical and Functional Architecture			PL	CP	CP	Instrumentation and Control - Physical and Functional Architecture	C8D6LA BXQF2A
1.16	Equipment or Component List	See TDTC	PL	CS	CP	UD	Component list	WBXM7R
1.17	Bill Of Material-BOM	See TDTC		PL	CS	CP	Bill of Material - BOM	W9ZCNP
1.18	System Detailed Performance Definition	See TDTC	If U	If U	If U		Technical Requirements Specification	WBYZ5V
1.19	Component Technical Specification			PL	CP	UD	Technical Requirements Specification	WBYZ5V
1.20	Assembly Drawing	See TDTC		PL	CP	UD	Assembly Drawing	CBU322

Appendix 2: Summary of the System Design Documents and maturity at gate (Table 9)

							Isometric Drawing	CBU3LR
							Support Drawing	CBU3KA
1.21	Cubicle Internal Definition	7KLR8R			CP	UP	Cubicle Internal Definition	BK6VFR
2.	[Definition Justification]							
2.1	Design Justification Plan	See TDTC	PL	CP	UD		Verification and Validation Plan	WCJ4P2
2.2	Design / Verification Compliance Matrix (DCM/VCM)	473LQM	PL	CS	CP	UD	Compliance Matrix - DCM or VCM or ICM	C7YUNE
2.3	Interface Compliance Matrix	3L775F			CP		Compliance Matrix - DCM or VCM or ICM	C7YUNE
2.4	Functional Analysis Report - FAR	See TDTC	PL	CP	UD		Functional Analysis	WBBZYV
2.5	Structural Integrity Report	35BVV3	PL	CS	CP		Structural Integrity Report	C7ZZBT
2.6	Calculation report (3)	See TDTC			CP	If U	Calculations	C826XY
2.7	Engineering Analysis (4)	See TDTC	PL	PL	CP	If U	Engineering Analysis	C824CS
2.8	Qualification Plan	XB5ABP		PL	PL	CP	Qualification Plan-QP	C94HZF
2.9	Qualification Summary Report for PIC Components	XB5ABP				CP	Qualification Synthesis Report for PIC Component	C94L6Z
2.10	Acceptance Plan (FAT, SAT)	See TDTC			PL	CP	FAT & SAT Plan and Procedure	CBUJD9
2.11	Factory Acceptance Test Procedure	See TDTC				CP	FAT & SAT Plan and Procedure	CBUJD9
2.12	System Commissioning Plan	VVSZNU		PL	CP		Commissioning Plan	WBYPHH
2.13	Commissioning Test Procedure	X8KGJE			PL		Commissioning Test Procedure	WBY7QR
2.14	Requirement Validation Matrix	7WT3PG		PL	CP		Compliance Matrix - DCM or VCM or ICM	C7YUNE
2.15	ROX and Research and Development Report	See TDTC	If U	If U	If U	If U	ROX and Research and Development Report	WCJ2U9
3.	[Manufacturing]							
3.1	Manufacturing execution document (manufacturing procedure, test procedure...) (5)	See TDTC				CP	Manufacturing execution document	CBQCMG
3.2	Part Drawing	See TDTC			PL ⁶	CP	Part Drawing	WAD9FG
3.3	Manufacturing Process Qualification Records	See TDTC				CP	Manufacturing execution document	CBQCMG
4.	[Assembly and Installation]							
4.1	Installation Drawing	See TDTC			CP		Installation Drawing	CBU2MH

Appendix 2: Summary of the System Design Documents and maturity at gate (Table 9)

4.2	Assembly or Installation Plan (<i>part of Construction Work Package Description-CWP</i>)	See TDTC		PL	CP		Installation Execution Document	CBUK45
5.	[Operation and Maintenance]							
5.1	Concept of Operations	XA95GG		PL	CP		Concept of Operations	WA44CK
5.2	Operation and Maintenance Manual	See TDTC			If U	PL	Equipment Operation and maintenance Manual	WNMXF4
5.3	System Maintenance and In-Service Inspection Plan	See TDTC		PL	CP		System Maintenance and In-Service Inspection Plan	WBZZXJ
6.	[Decommissioning]							
6.1	Decommissioning Plan	TYHA8S		PL	CP		Decommissioning Document	WA8RU6
7.	[Product Lifecycle Records]							
7.1	Design Plan	U34ACR	S	If U	If U		Design Plan	WBZTQN
7.2	Issue or Risk or Opportunity Analysis Report	22F4LE	S	S	S	UD	Not Applicable	N.A.
7.6	Quality Plan	22MFMW	If U	If U	If U	If U	DA-Suppliers Quality Plan DA Quality Plan Contractors Quality Plan	N.A.

Table 9 – Summary of the System Design Documents and maturity at gates

- (1) The maturity for Sub-System Requirements Document-sSRD is Consolidated at CDR and Complete at the PDR
- (2) Includes:
 - Specifications of I&C controller type (slow/fast), (conventional/interlock, Safety) and network interface configuration. [D5],
 - List of signals connected to the plant system I&C including name, type, sampling rate, allocation to I&C cubicle [D6],
 - List of the data at Central I&C interface [D7],
 - Hardware configuration of I&C cubicles showing the cubicle interfaces with Central I&C infrastructure, buildings, power supply and HVAC. [D8],
 - Description of plant system state machines (PSOS) with transitions and state variables. The deliverable includes the PSOS/COS mapping table. [D9]
- (3) Document type for final version of Computational Fluid Dynamics-CFD Analysis Report, Contamination Analysis Report, Electromagnetic-EM Analysis Report, Nuclear Analysis Report, Seismic Analysis Report, Structural and Thermal Analysis Report, Functional Analysis Report-FAR.
- (4) Document type for any Engineering Analysis such as 0D or 1D Thermohydraulic Analysis Report, ALARA Analysis Report, Analysis Model, Checklist for Analyses or Calculations, Constructability Analysis Report, EEE NRC Analysis Report, Fire Protection Analysis Report, Hazard Analysis Report (HIRA, HAZOP), Human Factors and Organizational Performance Report, Investment Protection Analysis Report, Logistics Analysis Report, Maintainability Analysis Report, Manufacturability Analysis Report, Nuclear Safety Analysis Report, Operation Analysis Report, RAMI Analysis Report - including FMEA or FMECA, Remote Handling Analysis Report, Scoping Calculation Report, Simulation Analysis Report, Task Analysis Report.
- (5) Document type for manufacturing input documents such as Calibration Plan (Manufacture), Data Sheet, , List of Manufacturing Tools and Equipment, Manufacturing Flow or Assembly Sequence, Manufacturing Instruction or Procedure, Manufacturing Plan, Manufacturing Process Qualification Report, Non-destructive Examination Procedure, Test Procedure, Training

Appendix 2: Summary of the System Design Documents and maturity at gate (Table 9)

or Qualification Record, Welding Data Input Package (for Manufacture), Welding Map (for Manufacture), Welding Procedure Specification-WPS, Welding Procedure Qualification Record-WPQR (for Manufacture), Material Property Report, Brazing Procedure Qualification Record-BPQR, Brazing Procedure Specification-BPS.

Appendix 3: Documents detailed contents and maturity at gates

For detailed descriptions of the above defined System design documents in Appendix 2 please refer to UID [ITER_D_43S7GL](#)

MQP Level 2

Procedure for Identification and Controls of Items

This MQP Level-2 procedure describes general procedure for identification and item control. General purpose of identification and item control are:

- To ensure the traceability from early design to dismantling of items
- To provide under operation constraint fast retrieval to item related information
- Full traceability, maintenance, etc.

The contents of this procedure are 1) control items and attributes, 2) identifiers, 3) labelling / tagging, 4) item control throughout the project lifecycle, 5) item lists, e.g. Bill Of Materials, BOM's and 6) item control mechanism relying on material management database system. Responsibility assignment regarding item control is also described. Since there are several procedures and instructions for labelling for different scopes already, this document provides harmonization of those existing documents related to physical identification,... (Please see complete abstract on document metadata.)

Approval Process			
	Name	Action	Affiliation
Author	Seo K.	03 Jul 2019:signed	IO/DG/COO/CIO/CMD/DCC
Co-Authors			
Reviewers	Brown R.	17 Jul 2019:recommended	IO/DG/COO/SCOD/OPD
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	Elbez-Uzan J.	17 Jul 2019:recommended	IO/DG/RCO/SD/EPNS
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	Lee H. G.	11 Jul 2019:recommended	NFRI - National Fusion Research Ins...
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Document Security: Internal Use RO: Fabre Nadine			
Read Access	LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: EMAB, AD: OBS - Quality Management Division (QMD) - EXT, AD: OBS - Quality Management Division (QMD), AD: Auditors, AD: ITER Management Assessor, project administrator, RO, LG: DO Support Team, LG: DO Suppo...		

<i>Change Log</i>			
Procedure for Identification and Controls of Items (U344WG)			
<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v0.0	In Work	26 Oct 2016	
v1.0	Signed	03 Aug 2017	first version as per approved MQP doc request URMJ6X
v1.1	Signed	18 Sep 2017	Considered the reviewer's comments on v1.0, and revised. Definition of terminologies and relationship to CM process are enriched, in particular.
v1.2	Approved	25 Sep 2017	As commented by CIO/CMD head, rev. nums. of the latest approved versions of the applicable documents are added.
v1.3	Signed	11 May 2018	As per MQP doc Request - WK7ES6 Includes Module H needs
v1.4	Revision Required	05 Jun 2018	Update of Table of content Change reference number 3 from 28WP2P superseded by UXM79P As per MQP doc Request - WK7ES6 Author is changed to includes Module H needs Consistency with other MQP documents regarding definition of terminologies, control gates, the MQP-tree, to be done in future major revision
v2.0	In Work	03 Jul 2019	As per approved MQP doc Request - XYC6CF, the list of main changes are: Change 1: PE/NPE requirement is added (integration of comments from v1.4); Change 2: DA applicable requirements are added; Change 3: - Definitions of terminologies are aligned and centralized (especially kinds of Item-ID-Codes); - Transfer of Bill of materials to construction is described as a critical activity of ID Process; - Listed requirements for each type of PA, Check List and recovery actions are added in the appendixes, as requested by users. For further details, the document had been pre-reviewed (Y8W4F9) and author provided a summary table including the answer per comment.
v2.1	In Work	03 Jul 2019	Fixed some broken formats
v2.2	Approved	03 Jul 2019	Fixed some broken format

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1 Purpose

This MQP Level-2 procedure describes the general procedure for Identification and Control of Items (ID) Process in accordance with QAP [1], Sec. 3. 6. Purposes of ID Process are:

- To avoid confusion between different items and/or items in different statuses, e.g. pass/fail at certain Control Gate, verification test;
- To record, monitor and to enable traceability for all controlled items and their attribute data, e.g. status, location (installed or stored), responsible entity/person, and related documentation;
- To provide fast retrieval of item-related information, e.g. as-built record, under operation constraint, damaged equipment; and
- To comply with the requirements of nuclear and other regulations.

The ID-Process aims at ensuring “Full Traceability” for the item itself and the related data/documents. During the project lifecycle, the state of an item evolves, e.g. as-designed, as-built, etc. Item-related data/documents are generated in each phase of the lifecycle, and validated at each Control Gate or Control Point, in terms of completeness, consistency, conformance, etc. To realize the Full Traceability, all status and the related data/documents are recorded in the dedicated IT databases.

Applicability of this MQP-L2 for PA :

- Applicable for PA’s to be signed;
- Regarding the signed PA’s, appropriate level of authority to decide through formal process.

Responsibility assignments within ID-Process are also described regarding five individual types of PA’s. Responsibilities of DA in each type of PA are summarized in Sections 6 and 7¹. Short guidance is described in Appendix-C.

2 Scope

The scope of this document and the related sections/paragraphs are as follows:

i.	Controlled items and their attribute data;	
ii.	The three types of key Item-ID-Codes respecting “Three Ball Model,” and other Item-ID-Codes;	(5.1)
iii.	Labelling and tagging to physical item;	(5.2 and Appendix-A)
iv.	Tagging to data/documents and/or to the described items in them, with Item-ID-Codes;	(5.3 and Appendix-B)
v.	Means for check of implementation and track, e.g. Control Gates ² , IT database system.	(5.4, 6 and Appendix-D)
vi.	Handover of material management and cataloguing related data to the IO construction entity (SmartPlant)	(5.4)

¹ As necessary, read other portions in the main content and the appendixes. Regarding in-cash contract, IO-Eng-RO to describe the ID-Process requirements in the contractual document, in compliance with this MQP document and the applicable MQP-L3’s.

² Control Gate definition to be documented by Design Control and Configuration Management Processes.

Where the Controlled Items are items belonging to one or more of the following categories:

- a) Items constituting the ITER System³, e.g. Components, Parts, (Sub)Assemblies;
- b) Temporary items, e.g. tooling, jigs, inspection equipment;
- c) Consumables, e.g. welding filler material, chemicals;
- d) Transportation package, e.g. crate;
- e) Spare parts

Within the Controlled items, “Items constituting the ITER System” or groups thereof, are specifically called ITER Individually Distinguishable Items, IDI’s. IDI is any item, or a group thereof, of interest to IO-CT’s, in particular for logistics <As-Delivered>; warehouse, construction and future operation and maintenance <As-Handled on the ITER site>.

2.1 Out of Scope

- ITER Buildings (civil structures), System and Sub-System⁴ are out of the scope;
- Definition of the required data and documents management according to the type of item in Engineering Phase, i.e. Design and Manufacture.

Note: the data structures and minimal requirements for the item lists (standard names for attributes of items[10]) are parts of the ID Process.

This MQP document provides the overview of the ID Process and associate requirements. The details for the implementation are described the level-3 MQP documents, specific Work Instructions (WI’s) and/or individual Technical Specifications of PAs and contracts, which will be generated by technical disciplines.

Fig. 1 shows the MQP document structure which details Section 3.6 of the QAP, the “Identification and Control of Items” process. Below MQP-L2 [U344WG] (this procedure), there are six MQP L-3 documents:

- 1) ITER Numbering System, e.g. ID-Code schema [3];
- 2) TTT-Codes to classify ITER Components [4];
- 3) Creation of Part Number of ITER, PNI and cataloguing [9];
- 4) Physical labelling and tagging [8];
- 5) Templates for BOM, Equipment List, etc., and standard attributes [10], and
- 6) Generation of ITER Bill of Materials (BOM) for Smart Plant Data Loading [36].

³ In other documents, this is named “ITER Plant”

⁴ The higher levels of the ITER PBS.

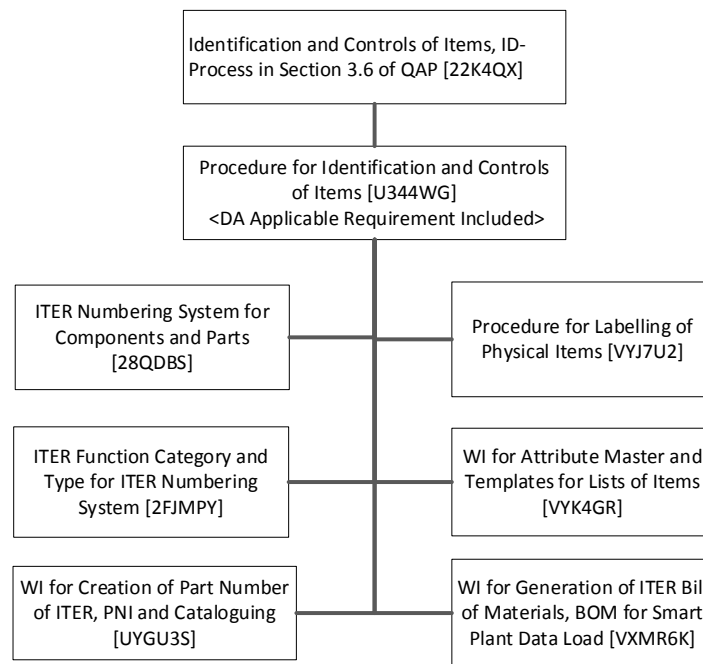


Fig. 1 MQP Document Tree Structure

3 Definitions and Acronyms

3.1 Definitions

1	3-Ball Model, 3BM	A data model aiming at identification and traceability of an item based on three key Item-ID-Codes and their relationship, namely Functional Reference Number (FR), Item-Type-Reference Num. (PNI) and Physical Item Ref. Num.(SN).
2	As-Built	Includes <as-manufactured>, <as-site-assembled>, <as-constructed>, <as-installed>. As-Built Item and the associated data/documents are tagged with the SN's and /or the Lot/Batch Numbers. <i>Note: As-Built Drawings differs from the original Design, Construction and Assembly Drawing." As-Built drawings describe the <u>real physical items</u> after manufacturing, site-assembly, installation, construction, etc., and include all changes, accepted non-conformities, etc.</i>
3	CAD-Ticket System	Used to generate or to change PNI's and TTT-Codes, and for cataloguing. Link: IO CAD Ticket System
4	Controlled Items	Items in the scope of the ID Process belonging to one or more of the following categories: 1. Items constituting the ITER System, e.g. Components, Parts, (Sub)Assemblies; 2. Temporary items, e.g. tooling, jigs, inspection equipment; 3. Consumables, e.g. welding filler material, chemicals; 4. Transportation package, e.g. crate, and 5. Spares of the above, as required.

		Those Controlled Items are in various states, such as “As-In the ITER System,” “As-Designed” and “As-Built.” As-Built Item is called “Physical Item,” as well.
5	Data/Documents	In this procedure, “Data/Documents” means, for example, Technical Specification, List of Items, Drawings, Diagrams, 3D Models, individual physical or functional data. Those Data/Documents can be the source data for SP Data Load.
6	Engineering Dossier	The engineering dossier is a container of technical information for a given scope and purpose, that forms the building-blocks of the ITER configurations and baselines. See CM Process MQP [2]
7	Functional Reference Number, FR	The unique code identifying an ITER Component within the ITER PBS, as detailed in [3]. FR is one of the 3 types of key Item-ID-Codes of the 3-Ball Model, identifying an item “As-In the ITER System.”
8	Handover Package (HOP) for Engineering Work Package (EWP)	See [7].
9	Item Type Descriptor	Item-Type-Descriptor is an <u>optional descriptive code</u> representing Item-Type tagged as well as PNI and/or MN. It can tag to an item accompanying with PNI. Item-Type-Descriptor is requested by IO Engineers to distinguish items without relying on any relational database, e.g. in a work field. The guideline and the format to be provided, later.
10	ITER Catalogue	Project-wide list of Standard Controlled Item-Types tagged with PNI’s, the relevant attribute data and the reference documents. See [9] for detail. Since the ITER Catalogue is not a tool for tracking design features of an Item-Type, only general properties to distinguish and to classify Item-Types are listed. Design information of each Item-Type and change on it are controlled with the design documents and/or the Engineering Dossier on PLM/Matrix. <i>Note that the 3D-Catalogue (or Library) is a different catalogue listing 3D-Models associated with CAD-oriented data.</i>
11	ITER Component	ITER Components are the lower nodes of the ITER-PBS. An ITER Component is a major piece of equipment uniquely located within the ITER System, such as a pump or a tank, which is tagged with a FR. <i>Note: FR’s do not exhaustively tag to items constituting the ITER system, but only tag to selected items, i.e. ITER Components, e.g. pumps, cables, supports, sensors. While PBS L1 to L3 Codes tag to items exhaustively within a same level. In other word, summation of items in each PBS level always becomes equal to the ITER System. For ITER Component tagged with FR’s, not.</i> TTT-Code as a part of a FR is used for the classification of ITER Components [4].

12	IO-CT Engineering Responsible Officer, IO-Eng-RO	IO-Eng-RO means TRO for PA, PBS-RO, Transverse Function RO, etc., who is responsible for a certain system, sub-system, equipment, component, etc., on the engineering side (not on the construction side) For EWP-HOP preparation, “EWP-Leader” corresponds to the IO-Eng-RO.
13	ITER Individually Distinguishable Item, IDI	IDI is an item or a group of items of interest to IO-CT’s, which constitutes the ITER System as a part/component. More specifically: • Item of as-delivered situation to the site (or to another manufacturer’s premises, as necessary); • Group of items to be site-assembled , e.g. kit of interface components; • Items to be dismantled and re-assembled on site; • Items subject to maintenance; Non-IDI: • Items shop-assembled together as part of the product before shipping, e.g. interior of IDI; <i>Note 1: Depending on purpose:</i> • <i>Items assembled as a part of the product before shipping, and to be physically integrated at the site, e.g. Programmable Logic Controller (PLC), signal conditioner, etc. are not IDI’s for logistics or warehouse, but are IDI’s from construction and maintenance point of view, since they need to be uniquely identified for installing the connections/cables with other equipment during the site-assembly activities;</i> • <i>On-site sub-assembly can be recognized as IDI.</i> <i>Note 2: All IDI’s or groups of IDI’s shall be tagged with PNI’s, and registered in SPMAT. Finally, relying on SPMAT, IDI’s are controlled in logistics, warehouse and construction.</i> <i>Note 3: Systematic grouping of items, “<u>kitting</u>” is recommended taking into account the site-assembly process, so that quantity of IDI’s to be managed is decreased.</i>
14	Item-Type	Design solution of item (independent of its instantiations), e.g. part, component, equipment represented with the Product Technical Specification, the Component Drawing, etc. <i>Note 1: IDI-Type is tagged with the Part Number of ITER, PNI, associated the Item-Type-Descriptor (optional) and/or the MN, as necessary. Any Item-Type should be identified and tagged with MN respecting the Quality Plan, QP [16].</i> <i>Note 2: All Standard Item-Types used in ITER are listed in the ITER Catalogue distinguish different Item-Types produced by a manufacturer catalogue.</i>
15	Manufacturer Model/Part Number, MN	The MN performs the same function of the PNI. MN’s are used by manufacturers within their catalogues to distinguish different Item-Types produced by the manufacturer. PNI’s are used in the ITER

		Catalogue to identify the same Item-Types, but accordingly to the ITER numbering conventions. <i>Note: MN is affixed to any item managed by the manufacturer respecting the contractual document and the Quality Plan (QP) thus establishing a link between PNI's and corresponding MN's and achieving full traceability down to the manufacture's data/documents.</i>
16	Packing List	See TDFC [15].
17	Part Number of ITER, PNI	The number identifying a given IDI-Type "As-Designed." PNI is one of the three key Item-ID-Codes of the 3-Ball Model. IDI, or groups thereof, shall be tagged with PNI. See ref [3].
18	Quality Control Records	Specified by Manufacturing Assembly and Installation, MA process. For DRR and CCR, all as-built data/documents are compiled as Manufacturing and Construction Quality Control Records, respectively. Tagging to physical items, to items in the data/documents and to the data/documents shall be ensured with these Quality Control Records.
19	Serial Number, SN	Key Item-ID-Code used to tag to physical item, "As-Built." SN's are used to distinguish different instances of the same Item Type. It can be Serial Number (SN), batch number, or lot number: • SN's are used for individual products; • Lot or batch number on multiple items of the same design, the same material, in the same contract/production, etc. <i>Note-1: In this document SN represents all Item-ID-Codes, e.g. Lot/Batch Num., tagging to As-Built item.</i> <i>Note-2: Only with SN, sometimes items are not uniquely identified. However, Item-Type-Code, e.g. PNI, MN, followed by SN is always the unique identifier.</i>
20	Standard/Non-Standard IDI-Types	Items are separated between Standard/Non-Standard IDI-Types in the material management system. "Standard IDI-Types" are created for use of 1) Bulk procurement by IO for construction, 2) Procurement and stock of spare equipment and parts, etc. • The Standard IDI-Types are typically: ○ Industrial standard parts, e.g. EN or ASME Pipes; ○ Parts or equipment of COTS items (catalogue by suppliers); ○ Some custom design items controlled by IO, for instance with the technical specification/dossier and/or in 3D Library; • "Non-Standard IDI-Types" are normally associated with custom components that have been designed and manufactured explicitly for ITER.
21	Tag	Tag means an ID-Code attached to an item, a data/document, etc., or

		an action to affix an ID-Code. Usually, in plant construction, the word “Tag” is used with the same meaning as “FR” affixed to a functional component. Consequently, “a tagged item” means an item designated with FR.”
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3.2 Acronyms

Abbreviation	Description
BOM	Bill of Material
CCR	Construction Completion Review
CM	Configuration Management
COTS	Commercial Off-The-Shelf
CRR	Construction Readiness Review
CWP	Construction Work Package
DA	Domestic Agency
DRR	Delivery Readiness Review
EWP	Engineering Work Package
FR	Functional Reference Number
GA	General Arrangement (Drawing)
HOP	Hand-Over Package
IWP	Installation Work Package
MN	Manufacturer Model/Part Number
MRR	Manufacturing Readiness Review
NPE	Nuclear Pressure Equipment
P&ID	Process and Instrumentation Diagram
PA	Procurement Arrangement
PE	Pressure Equipment
PFD	Process Flow Diagram
PIC	Protection Important Component
PNI	Part Number of ITER
QP	Quality Plan
RASCI	R: Responsible, A: Accountable, S: Support, C: Consulted and I: Informed
SIC	Safety Important Component
SMDD	System for the Management of Diagrams and Drawings
SN	Serial Number
SP	SmartPlant
SPMAT	SmartPlant Materials
SPRD	SmartPlant Reference Data
UID	Unique Identifier
UOM	Unit of Measure
WI	Work Instruction
WP	Work Package

For other abbreviations, see; <https://portal.iter.org/Pages/abbreviations.aspx>

4 Reference Documents

Title of Document	UID
[1] Quality Assurance Program, QAP	22K4QX

[2]	Procedure for Configuration Identification and Status Accounting	TZV743
[3]	ITER Numbering System for Components and Parts	28QDBS
[4]	ITER Function Category and Type for ITER Numbering System	2FJMPY
[5]	Specification for Labelling of Equipment on ITER Project	TL25DK
[6]	ITER Site Signage & Graphics Standards	4ALJEU
[7]	WI for Construction Preparation (EWP/CWP/IWP)	UYGEDA
[8]	Procedure for Labelling of Physical Items	VYJ7U2
[9]	Procedure for Part Number of ITER, PNI and Cataloguing	UYGU3S
[10]	WI for Attribute Master and Templates for Lists of Items	VYK4GR
[11]	Instructions for CAD Documents Used for Tokamak Assembly Contracts	UC6CU3
[12]	TDFC Bill Of Material T4.0 S1	W9ZCNP
[13]	TDFC Equipment Component List T4.0 S1	WBXM7R
[14]	TDFC Deliverable List T5.5 S3	WA93DF
[15]	TDFC Shipping or Logistics Record T5.1 S3	WCGGUH
[16]	Requirements for Producing a Quality Plan	22MFMW
[17]	Procedure for the Preparation, Review, Approval and Award of Procurement Arrangements	2W4F7A
[18]	Sign-Off Authority (SOA) for Project Documents	2EXFXU
[19]	ITER System Design Process (SDP) Working Instruction	4CK4MT
[20]	Annex B Template Technical Functional Specification	28B3SF
[21]	Working Instruction for Manufacturing Readiness Review	44SZYP
[22]	Working Instruction for Construction Readiness Review	QXW4KQ
[23]	Working Instruction for the Delivery Readiness Review (DRR)	X3NEGB
[24]	Procedure for Transportation of Components to ITER Site	RY5C6Q
[25]	Procedure for Reception of Components at the ITER Site	RXCTBZ
[26]	Procedure for the Storage and Preservation of ITER Components at the ITER Site	RWYED5
[27]	Quality Classification Determination	24VQES
[28]	Safety Important Functions and Components Classification Criteria and Methodology	347SF3
[29]	List of the ITER Nuclear Pressure Equipment	34MZKE
[30]	List of Protection Important Components (PIC list) (EN)	JDS5K7
[31]	Procedure for the Management of Diagrams and Drawings in pdf Format Using the SMDD Application	KFMK2B
[32]	Pressure Equipment Directive 2014/68/UE	-
[33]	French ESPN Order dated 30 December 2015	-
[34]	Implementation for Design and Manufacture of PE/NPE	VE2DSP
[35]	Procedure for the Preservation of Equipment	WML9CF
[36]	Work Instruction for Generation of ITER Bill of Materials, BOM for SmartPlant Data Load	VXMR6K

5 Basic Principles

Objectives of Identification and Control of Items (ID) Process are:

- To avoid confusing items of different grades, etc.;
 - To enable traceability of the concerned items:
 - To retrieve all related information efficiently in order to meet operational incident resolution needs;
 - To ensure proper execution of preventive inspection and maintenance;
 - To find compatible product for replacement;
 - To obtain the status of items associated with Control Gate/Point, etc.:
 - Inspection results (by Pass/Fail/Hold);
 - Current location;
 - Responsible person/entity;
 - Reception date, etc.
 - To control spares and items subject to maintenance;
 - Full traceability: To enable linking any relevant data/document for the concerned item;
 - To perform continuous process control & monitoring (status accounting).
 - At each Control Gate/Point, to ensure completeness, consistency and conformance within all the items and the item-related data/documents, i.e. the source data.
 - To comply with the nuclear safety and other regulatory requirements;
- Note: ID-Process is a cross-cutting process over multiple MQP Processes (See Sec. 8).

In Sections 5.1 to 5.4, as an outline the ID-Process, the following are described; 1) Three Ball Model and the Item-ID-Codes, 2) Physical Label, 3) Item-Related Data/Documents, and 4) Cataloguing and material management in the ITER Construction Management System.

5.1 Three Ball Model and Item Identification

The principle of Three Ball Model (3BM) is applied to the ID-Process. As shown in Fig. 2, in 3BM, there are three states of the same item. Each state of item is tagged with a dedicated key Item-ID-Code [3], as follows:

- i. **Functional Reference, FR** tags to an item <As in the ITER System>, called “ITER Component”;
- ii. **Part Number of ITER, PNI** tags to specified design solution of item, <As-Designed>, called “ITER Item-Type”;
- iii. **Serial Number, SN** tags to an item <As-Built>, called “Physical Item.”

Where “As-Built” stands for As-Manufactured, As-Site-Assembled, As-Constructed, or As-Installed.

Note: Within this document, SN often represents all Physical Item ID Codes including Lot/Batch Num., Heat Number for metallic raw material, etc., for simplification.

Those key Item-ID-Codes are used to identify the different states the same item throughout the project lifecycle.

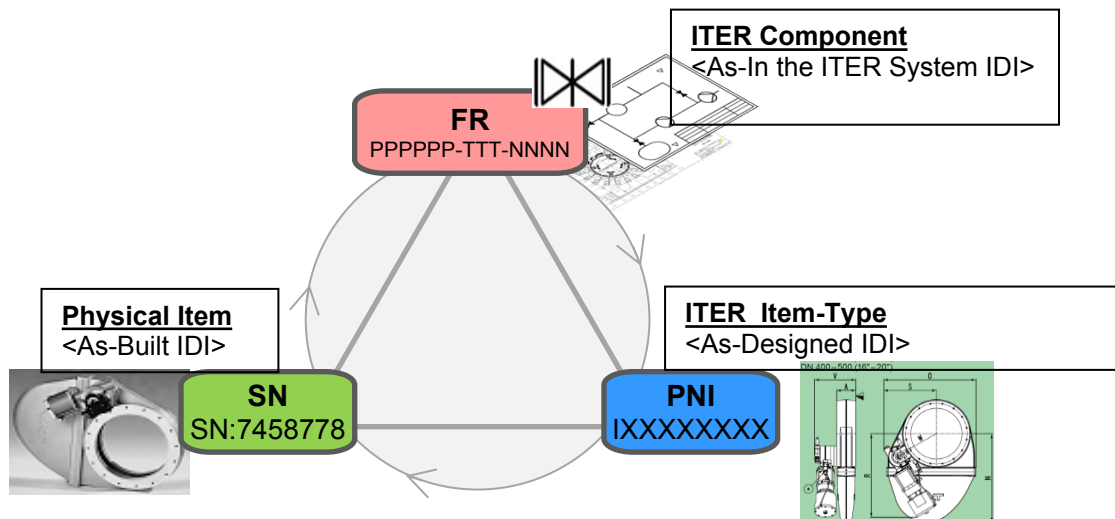


Fig. 2 Three Ball Model [3]

Among Controlled Items, Individually Distinguishable Items (IDI's) are controlled by IO-CT according to the 3-Ball Model.

Note that a mechanical ITER Component tagged with FR can be physically constituted with several IDI's tagged with individual PNI's, which are site-assembled together. The assembled item is recognized as the Parent IDI. While the constituting items are the Children IDI's.

Fig. 3 shows the tagging with Item-ID-Codes, i.e. FR, PNI and SN, throughout the project lifecycle including the Control Gates. This figure is explained in paragraphs 5.1.1 to 5.1.4.

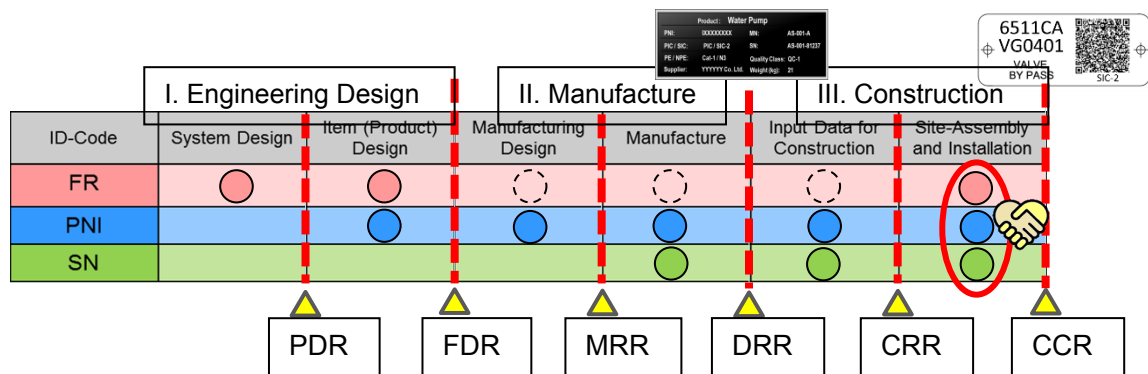


Fig. 3 Lifecycle of an IDI tagged with key Item-ID-Codes. At installation, all three types of key Item-ID-Codes are connected together [3]. Physical labelling occurs accordingly.

5.1.1 FR Creation and Tagging

- During the system design, all ITER Components shall be identified within diagrams, e.g. P&ID, Cabling Diagram, and/or in the Drawings/3D-Models, e.g. GA, Layout Drawing, CMMs, and tagged with FR's [3];
- Since FR's tag to only ITER Components, which have certain functions in the ITER System, e.g. water pumps, mechanical supports, not all IDI's used for the site-assembly are tagged with FR's;
- FR is generated by the IO-Eng-RO, then approved with the diagram and the Equipment List, Line List, etc.;

- All necessary FR's shall be generated no later than at FDR;
Note: FR is not relevant during the Manufacture Phase (See the circles with dashed lines⁵ in Fig. 3).

5.1.2 PNI Creation and Tagging

- Following the system design, the system is decomposed into assembly-level, then into individual item (or IDI)-level. After the decomposition, items are grouped by technical requirement⁶, then designed as the identical design solution, i.e. IDI-Type tagged with PNI [3], [9];
- IDI's or groups of IDI's shall be tagged with PNI's, exhaustively. This implies that any item or group of items in Product or Assembly Drawing, shall be tagged with a PNI.
Note: Exhaustive means tagging all small items individually, e.g. bolts, nuts; but also includes items which have been kitted (items grouped together). By kitting, quantity of necessary PNI's can be decreased.
- Only IO-Eng-RO can request new PNI's via CAD-Ticket System.
If DA/Manufacturer requires additional new PNI's, they shall be request via the IO TRO;
- Newly generated IDI-Types tagged with PNI's are registered in the ITER material management system, SPMAT, associated with the attribute data. New Standard IDI-Types not included above yet are also included in the ITER Catalogue;
- Tagging with PNI may be required any time, including after the item design has finished;
- The format of PNI is specified in [9];
- All necessary PNI's shall be generated no later than MRR.
- PNI's on a physical item, on the 3D model, on those in data/documents and tagging to the related documents shall be the same. Even if a new format of PNI is requested via update of the approved MQP document [9] in the meantime, keep the original format of PNI.

5.1.3 SN Creation and Tagging

- All manufactured and/or procured items shall have SN and/or Lot/Batch Num.
Note: Physical tagging with SN and/or Lot/Batch Num. shall be done, as necessary, so as to enabling tracing back the as-built records, e.g. the mill certificate, the inspection report, the calibration report;
- Manufacturer can decide the format of the SN, and whether or not to tag a physical item with a SN, if it is not specifically required;
- Physical items are tagged with SN's and/or Lot/Batch Nums., no later than DRR;
- As-Built PIC/SIC items shall be tagged with SN and/or Lot/Batch Num., physically and/or in the list of As-Built IDI's, so as that the related data/documents, e.g. Non-Conformity Reports are fully traceable.

⁵ Major equipment with designated installation point in the ITER System can be tagged with the FR at the manufacturer's premises before shipment. Unique IDI's in the ITER System like pre-fabricated pipe spools are also tagged with FR's.

⁶ This process is called as "Decomposition and Abstraction," or "Standardization." Consequent Item-Type-List is called "Catalogue."

5.1.4 Link between FR, PNI and SN

- When the delivered Physical Item is installed in the plant as an ITER Component, then it shall be tagged with the FR. At this final stage, a one-to-one relationship between SN and FR is established, and the three key Item-ID-Codes are consolidated;
- All items installed in the ITER System shall be tagged with the three Item-ID-Codes no later than CCR.

In Fig. 3, physical labels, i.e. Product Label and ITER Component Label, which include the Item-ID-Code(s), shall be affixed to the item no later than DRR and CCR, respectively.

During the project lifecycle, the related data/documents of these IDI's are also tagged with these key Item-ID-Codes. Finally, in the operation phase, any data/documents related to an ITER Component is retrievable with the "FR" linked together with other two, namely "PNI" and "SN." If replacement of an ITER Component becomes necessary, the PNI is found by referring to the FR. The cause of the failure of the ITER Component is to be investigated with the As-Built Quality Control Records tagged with the SN.

5.1.5 Manufacturer Model/Part Number, MN

- The MN has the same function for the manufacturer as the PNI has for ITER. They both identify Item-Types;
- Manufacturer shall tag to all the items and the item-related data/documents with MN's, respecting their Quality Plan (QP) [16].
If the PNI is affixed to an item and referred to in the data/documents, the MN is not always necessary;
- Manufacturing Quality Control Records shall be tagged with MN (and PNI), and SN/Lot Num.;
- COTS items are already tagged with MN's in the manufacturer or supplier commercial catalogue. PNI's shall tag either to individual COTS items or to a group of them, in addition to those MN's;
- The link between PNI and MN is critical, since the link allows IO-CT to trace any ITER Item to the detailed manufacturing data/documents, and in so doing enables the Full Traceability of all item-relevant data;
- For IDI's, the MN will be recorded with the PNI in item lists in Manufacturing Dossier and Quality Control Records, e.g. As-Built IDI List;
- DA/Manufacturer should provide to IO-CT for information the MN-Code Scheme used for a group of IDI's before the MRR.

5.1.6 Others

- Consumables, General Tooling, etc. shall be tagged with PNI and SN and/or Lot/Batch Num.;
- CAD-Model Items are also tagged with FR's and/or PNI's, so that 3D models and Assembly Drawings related to an IDI can be easily identified.

5.2 Physical Labels and Marks

Physical labelling to each actual item is required. Fig. 4 shows an example of some typical labelling and marking. The mandatory contents are specified in ref [8] and Appendix-A. When ITER acts as manufacturer of PE and NPE, SN's and/or Lot Num. shall tag to the

concerned items physically according to the requirements of IO implementation plan for the manufacturer of PE/NPE [33], [34], [35].

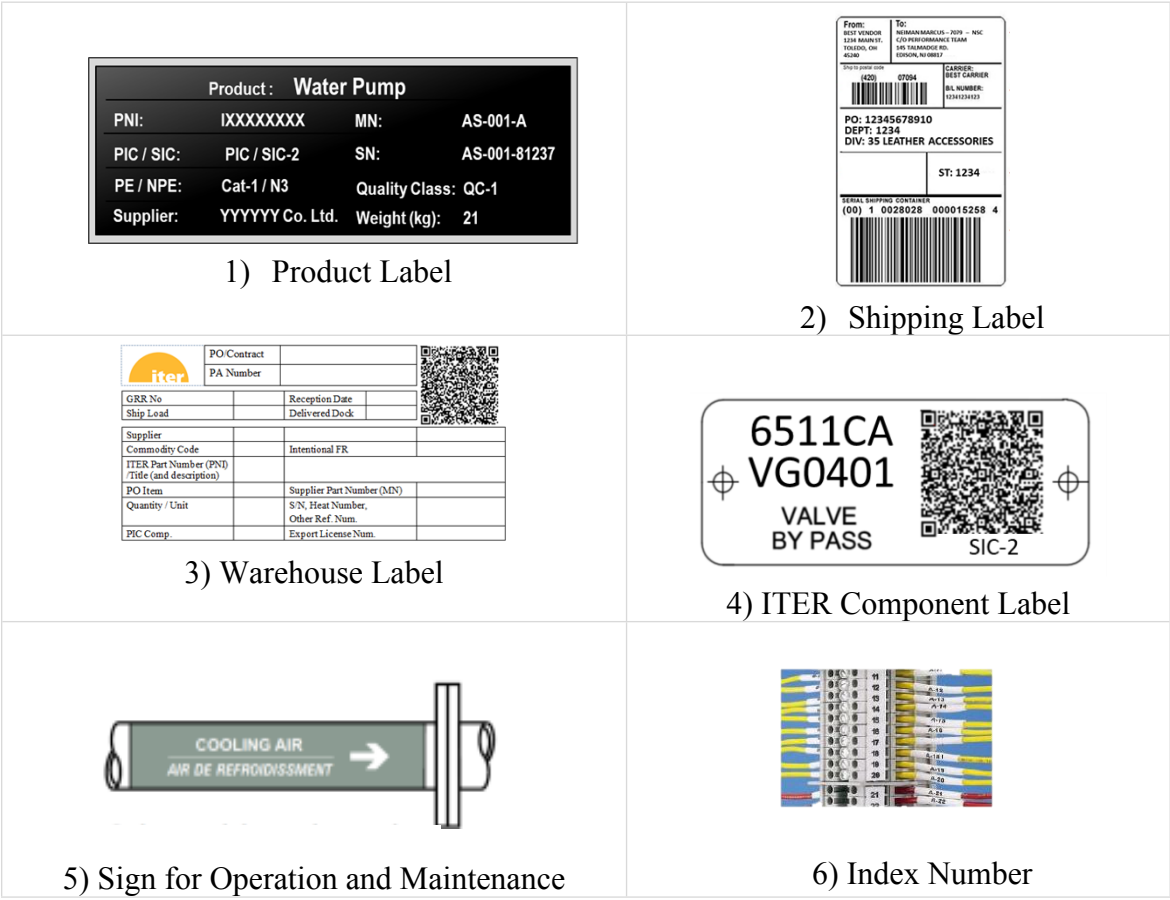


Fig. 4 Physical Identification Labels/Tags

1) Product Label

In Fig. 4-1), the Product Label includes a) the Part Number of ITER (PNI), b) the Manufacturer Model/Part Number (MN), and c) the SN. The Manufacturer shall attach the Product Labels or Tags physically to each item. Other marking, e.g. “CE” should accompany the Product Label, as necessary.

Note: For instance, if the area is limited, at least one Item-ID-Number to enable tracing back the data/ documents. For small items, e.g. bolts, nuts, tagging/labelling may not be required.

2) Shipping Label

See in Fig. 4-2) and ref [8]. (Scope of HS Process)

3) Warehouse Label

See in Fig. 4-3) and ref [8]. (Scope of HS Process)

4) ITER Component Label

In Fig. 4-4), FR is written on the label. The QR code can facilitate the access to the IT Database [5].

5) Signs

Fig. 4-5) shows a general sign on a pipeline, with the fluid-type name and the pipeline ID-Code [6].

6) Index Numbers

Fig. 4-6) shows an example for Index Number. The indexing rules, e.g. counting in clockwise or counter-clockwise direction shall be documented prior to the implementation.

Extended FR's for this purpose is explained in [3]

5.3 Item-Related Data/Documents

Fig. 5 shows the relationship between key Item-ID-Codes, a) attribute data of the item, b) data/documents tagged with the Item-ID-Codes, and c) data/documents in which the item tagged with the Item-ID-Code(s) is included. In other word, b) and c) are data/documents defining the item (or the report/record) and those describing (sub)system or an assembly including the item, respectively. Depending on key Item-ID-Code(s), the related data/documents are different. Similarly, types of Item-ID-Codes used as primary key code in various item lists are different.

If data/documents are related to items in the ITER System, i.e. to "ITER Components," the primary key Item-ID-Code is the FR. The maintenance report for the ITER Component is tagged with the FR. An operating temperature rating for certain ITER Components, is associated with that FR. Items tagged with FR's are included in the Equipment List, diagrams, etc.



Key Item-ID-Code	a) Attribute Data	b) Data/Documents tagged with Item-ID-Code	c) Data/Documents describing items tagged with Item-ID-Codes
FR ITER Component <As-in the ITER System>	System Physical / Functional Properties, e.g. GBS, max flow	Installation Procedure / Records, Operation Manual/ Records, Maintenance Records (Site-Assembly) Design Definition Dossier, etc.	System Design Definition Dossier including GA, PFD, P&ID, etc.
PNI ITER Item-Type <As-Designed>	Item Physical / Functional Properties, e.g. Output Power	Product Design Definition, e.g. Product Tech Spec, Component Drawing, Data Sheet, Deviation Request*, etc. Manufacturing Dossier, etc.	Assembly Drawing, BOM, Construction Process Description (CPD), etc.
SN Physical Item (As-Built>	Item As-Built Physical Properties, e.g. As-Built Tolerance	Mill Certificate, Inspection Report, Non-Conformity Report, etc. Quality Control Records, etc.	List of As-Built Items, As-Built Drawing, etc.

*) A Deviation Request can also be related to a specific physical item tagged with SN.

Fig. 5 Correlation between key Item-ID-Codes, a) attribute data, b) tagged data/documents and c) data/documents describing items tagged with Item-ID-Codes

Similarly, data/documents related to Item-Type <As-Designed>, like product technical specification, are tagged with PNI's. Items tagged with PNI's appear in Assembly Drawings, BOMs, etc.

Finally, data/documents related to Physical Items <As-Built>, like Product Inspection Reports, Sensor Calibration Report, Non-Conformity Reports, etc. are tagged with SN. As-built data, like as-built dimensions, are also associated with SN.

5.3.1 Data/Documents Tagged with Item-ID-Codes

Data/ Documents related to IDIs shall be tagged with Item-ID-Codes, so that those data/ documents can be searched, filtered and/or sorted by Item-ID-Code, over the project lifecycle. Data/Documents tagged with various types of key ID-Codes are explained in more detail below.

Data/Documents Tagged with FR

- Installation records, calibration and/or maintenance reports of ITER Components are tagged with the FR;
- These documents are issued during installation or in subsequent phases of the project.
Note: After the system design is finished, the need for documents tagged with the FR is rare until the beginning of the Construction Phase.

Data/Documents Tagged with PNI (and MN)

- Documents describing product design definitions are tagged with PNI's and/or MN's. Examples include product technical specifications, requirement specifications, drawings, etc.;
- Optionally, PNI can be followed by Item-Type-Descriptor (in parentheses, in order to avoid confusion), for instance "I12345678 (XXX-XXXXXX-XXXXX)".
Note: Item-Type-Descriptor is a descriptive code to be developed by IO-Eng-RO, as necessary. If applicable, the MN may be used as the Item-Type-Descriptor;
- Respecting the Quality Plan, QP, all manufacturing documents shall be tagged with MN's, which are partly linked with PNI(s). This link is critical to achieve full traceability down to the specific manufacturer's data/document.

Data/Documents Tagged with SN

- As-built reports, e.g. mill certificates, as-built drawings, inspection reports are tagged with SN or Lot Num. ;
- One Lot, Batch or Heat Number can be associated to multiple Physical Items. This means that one mill certificate tagged with a Batch/Lot Num. refers to those multiple Physical Items.

Data/Document for Consumables, Tools, etc.

- Consumables and tools may not be IDI's, but these items and their related documents are tagged with PNI's;
- Related documents to these items are, for example:
 - Regular inspection and/or maintenance reports for tooling;
 - Calibration reports for inspection equipment;
 - Material Safety Data Sheet (MSDS) for chemicals, etc.

5.3.2 Data/Documents Describing IDI's Tagged with Item-ID-Codes

Items are controlled with various kinds of specific item lists. For instance, items are listed in a) Equipment List, b) BOM and c) List of As-Built IDI's generated in a) System Design, b) Site-Assembly/Item Design, and c) Manufacture, respectively. These item lists are associated with the Diagrams/Drawings, in which the items are described. Table B-1 shows the relevant types of specific item lists and the typical contents within ID Process.

Finally, ITER-BOM for SmartPlant Data Load is generated from the data/documents mentioned above, as the "source data."

5.4 Cataloguing and Material Management in the ITER Construction Management System

The ID-Process relies on the IT database system, namely SmartPlant (SP).

SP Data Loading with ITER-BOM consists of two parts:

SP Data Load-1:	Identification of IDI-Types, PNI Generation and Cataloguing [9]
SP Data Load-2:	Completion of all attribute data of IDI's on SPMAT [36]

Fig. 6 shows the two parts of the SP Data Loads during the project lifecycle. The ITER-BOM [36] is a specially prepared spreadsheet, which is different from traditional engineering item lists, e.g. Equipment List, BOM, for the data loading on SmartPlant at SP Data Load 1&2. After loaded on SPMAT/SPRD, the loaded data can be managed in an intelligent manner.

Note that the source data, e.g. traditional item lists, e.g. Equipment List, Line List, BOM for Design or Manufacture, shall be generated and controlled by the IO-Eng-RO, since the contents of the ITER-BOM are relevant only to logistics, warehouse management, construction and additional procurement, and following phases.

Additionally new data/documents for the warehouse control, the construction design and the as-built, etc. shall be added during the construction phase. More detailed steps of the process are described in the following section.

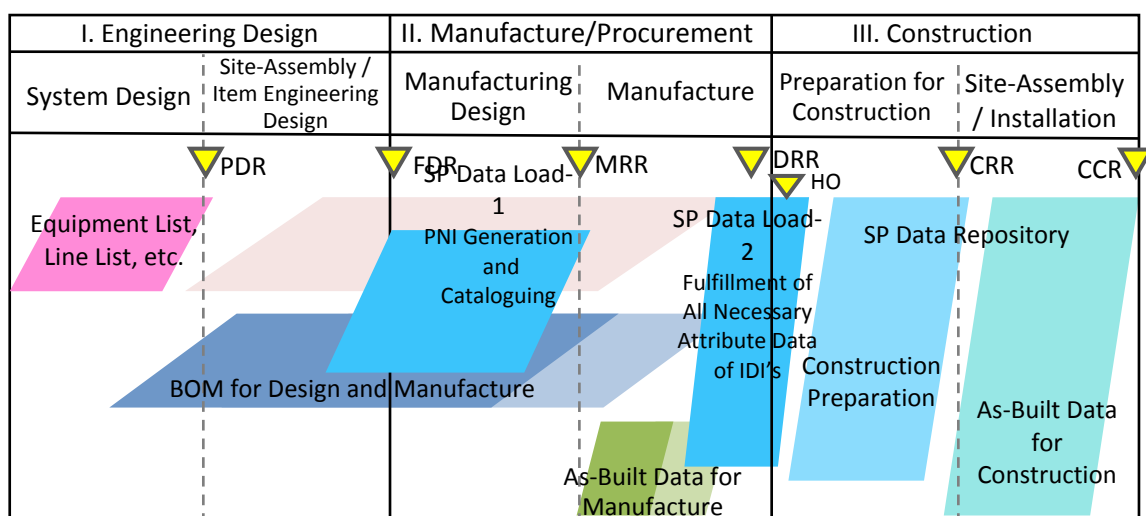


Fig. 6 Summary of the item-centric data/documents management

The SP Data Loads 1&2 are only summarized here. The detailed steps are described in MQP-L3 documents and the specific WI's [9], [36].

5.4.1 *SP Data Load-1: Identification of IDI's, PNI Generation and Cataloguing*

- ITER Individually Distinguishable Item, IDI shall be tagged with PNI;
- The IO-Eng-RO shall request the necessary PNI's via the CAD-Ticket System [9];
- The uniqueness of the PNI is verified with SPMAT/SPRD, then the proposed PNI is validated;
- After the validation, the IDI's tagged with the PNI's are registered in SPMAT associated with other attribute data;
- If the IDI is recognized as a Standard IDI, Tag & Item-Data Admin provides a dedicated format of PNI, which is then registered in the ITER Catalogue on SPRD.

5.4.2 *SP Data Load -2: Completion of All Attribute Data of IDI's on SPMAT*

- The data to be loaded at the SP Data Load-2 shall be validated in consistency with the official contents in the EWP-HOP [36].
- SPMAT data loading with the designated template of ITER-BOM to be completed before CRR;
- All listed IDIs, except for spares, are correlated with Contract, EWP/CWP, Assembly Requirement Drawing [11], etc. within the ITER-BOM to be loaded.

6 Workflow

Fig. 7 shows the flowchart of the ID-Process. There are three phases, i.e. I) Engineering Design, II) Manufacture/Procurement, and III) Construction. Six Control Gates and two Control Points, i.e. PA-Signed (an example of B-t-P PA) and Handover, HO, where data transfer occurs from one entity to another, are described. At each Control Gate/Point, status of each item is verified with the data/documents in the Engineering Dossier.

The two steps of SP Data Loads 1&2 are shown on the right of the workflow.

General rules:

- All items and the data/documents shall be tagged with FR, PNI and/or SN, as necessary;
- In Fig. 7, only general responsibilities are specified. Specificities of five individual types of PA's are explained later, according to this flowchart;
- This flowchart shall be respected in order to generate a technical specification for a direct contract by IO-CT as well;
- Execute Steps I-1 to III-6, sequentially. The order may be parallel or switched, but required process steps shall be completed before the designated Control Gate (See the Check List in Appendix-D) ;
- At each Control Gate, the completeness, consistency and conformance of various item lists including the ITER-BOM and the source data/documents shall be ensured;
- SP Data Load-1, i.e. PNI generation, registration on SPMAT, and cataloguing [9], shall be completed at the latest before MRR;
- SP Data Load-2 shall be completed after the HO, no later than CRR on the basis of the information provided for the EWP.

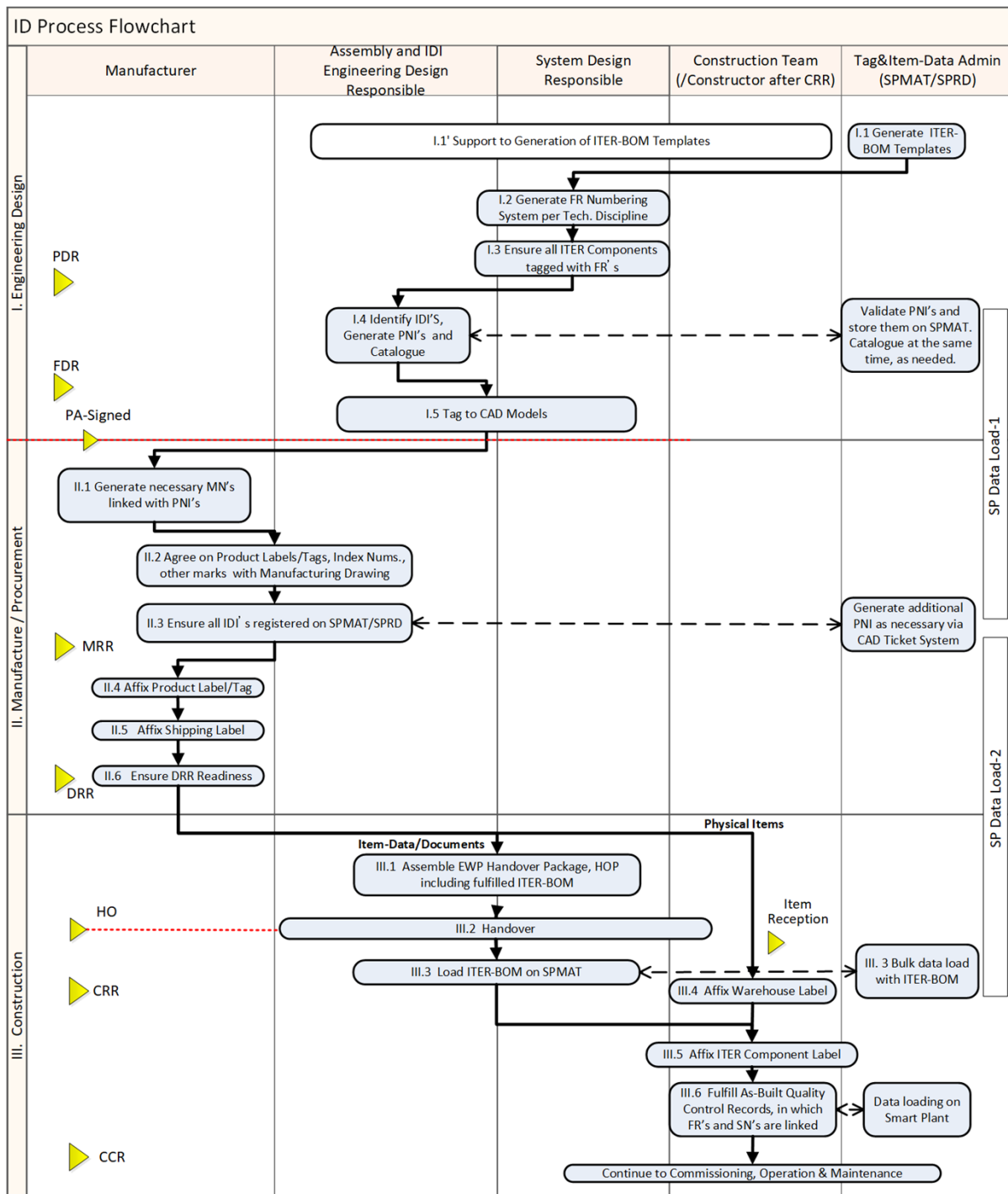


Fig. 7 Flowchart. This flowchart is valid for B-t-P PA as it is. Responsibility assignments for each type of PA are described in Section 7.

6.1 Process Steps

6.1.1 I. Engineering Design

I. a) System Design (Control Gate: PDR)

I. 1 Generation of ITER-BOM Templates

- Tag & Item-Data Admin shall generate ITER-BOM Template for each technical discipline, e.g. piping, mechanical, supported by IO-Eng-RO's and Construction Team.

I. 2 Generate FR Numbering System per Discipline

- System Design Responsible shall generate FR Numbering System per Technical Discipline;
- The document for the FR schema shall be approved before the implementation.

I.3 Ensure all ITER Components identified and tagged with FR's

- System Design Responsible shall tag to designed (major) ITER Components with the FR's, in the data/documents, e.g. diagrams, Equipment Lists, Line Lists;
- FR's are validated at the approval of the related data/ documents, e.g. Equipment List, Line List, diagrams.

I. b) Site-Assembly and Item Engineering Design (Control Gate: FDR)

I. 4 Identify IDI'S, Generate PNI's and Catalogue – SP Data Load-1 [9]-

- Assembly & IDI Engineering Design Responsible shall:
 - Identify all IDI's to be tagged with the PNI's;
 - Request the PNI's via IO-Eng-RO, who will issue a CAD-Ticket to obtain the necessary PNI's;
- Once the PNI's are validated, those IDI's are registered in SPMAT;
- Among them, Standard IDI's are catalogued in the ITER Catalogue on the dedicated IT database, SPRD (See the criteria in 3.1 Definition).

I. 5 Tag to CAD-Data, i.e. CAD-UID with FR and PNI

- System and Assembly & IDI Engineering Design Responsible with CAD-Designers shall tag to CAD Data with the FR's and/or the PNI's, so as that the CAD-UID's and the FR's and/or PNI's are correlated.
Note that the CAD-Data is one of the critical source of data for the ITER-BOM related to the site-assembly work, namely the "Site-Assembly Drawing⁷."

All ITER Components shall be identified and tagged with FR's no later than FDR.

6.1.2 II. Manufacture/Procurement

II. a) Manufacturing Design (Control Gate: MRR)

II. 1 Manufacturer to generate all necessary MN's (linked with PNI's) [3]

The Manufacturer shall:

⁷ Those to be controlled on PLM. At present, those are stored in SMDD[31].

- Generate Manufacturer Model/Part Numbers, MN's tagging to all concerned items, including Non-IDI's, under control of the Manufacturer;
- Generate a list of IDI's to correlate the PNI's, the MN's and the SN's.
Note: Make reasonable groups of items in order to facilitate tagging with PNI's.

II. 2 Agree on Product Labels/Tags, Index Num.s., other marks with Manufacturing Drawing

Manufacturer and IO-Eng-RO shall agree on Product Labels/Tags, Index Num.s., other marks with Manufacturing Drawing, before the MRR.

II. 3 Ensure all IDI's are planned and registered on SPMAT

- The Manufacturer shall generate a list of planned IDI's to deliver;
- The IO-Eng-RO shall ensure all IDI's are planned and registered on SPMAT (SP Data Load-1)
Note: Necessary quantities including spares shall be ensured.

II. b) Manufacture (Control Gate: DRR)

II. 4 Affix Product Label/Tag

- The Manufacturer shall affix the product labels/tags including the necessary data.

II. 5 Affix Shipping Label

- Manufacturer or transporter shall affix the shipping labels including the necessary data.

II. 6 Ensure DRR Readiness

- HS Process to specify in detail[23];
- Respecting the HS Process; verify the controlled item and that the identification provided on the labelling/tagging matches what is stated on the DRR documentation (Manufacturing Dossier, Release Note, Delivery Report, Packing List) per the DRR Working Instruction [23])

6.1.3 III. Construction

III. a) Preparation for Construction, e.g. Handover (Control Gate: CRR)

III. 1 Completion of ITER-BOM

- The IO-Eng-RO, in this case the "EWP Leader⁸," shall complete EWP-HOP including the completed ITER-BOM.
Note: All attribute data required with the template shall be consistent with the source data

III. 2 Handover, HO

- Handover from IO-Eng-RO to Construction Team [7];
- If the ITER-BOM is loaded on SPMAT(/SPRD) before HO, a) reloading on SPMAT or b) re-verification on SPMAT with respect to the accepted HOP is needed.

⁸ Construction Team is using this terminology, "EWP Leader."

III. 3 Load ITER-BOM on SPMAT

- Tag & Item-Data Admin shall load the fulfilled ITER-BOM on SPMAT (SP Data Load-2).

III. b) Construction (Control Gate: CCR)

III. 4 Affix Warehouse Label

- Once IDI's are received, the Construction Team shall affix Warehouse Labels for the site material control.

III. 5 Affix ITER Component Label

- At completion, e.g. installation of an ITER Component, the Construction Team or DA in charge of the construction shall affix the ITER Component Label.

III. 6 Fulfil As-Built Quality Control Records, in which FR's and SN's are linked

- Tag & Item-Data Admin shall load the as-built data on SmartPlant, in order to create the link between the FR, the PNI(s) and the SN(s).

Once Commissioning, Operation & Maintenance, and subsequent phases are specified in official MQP documents, this MQP-L2 should be revised. At minimum, any controlled items and data/documents used or generated in those phases shall be tagged with the Item-ID-Codes properly for full traceability purposes.

7 Responsibility

In this section, the general responsibility of each role is described first, then the specific responsibility assignments for all five types of PA's are explained in Paragraph 7.2 (Tables 1 to 5).

7.1 General Responsibilities

7.1.1 IO-Eng-RO (and Supervisor)

- Generate contractual documents and/or technical specifications, e.g. PA-Annexes A and B in compliance with this procedure and the associated MQP-L3 procedures
Note: This MQP-L2 will be listed in the DA Applicable Documents in PA-Annex-A;
- Generate and validate specific templates of item lists, e.g. Equipment List, necessary for Engineering Design;
- Generate FR Code Schema per technical discipline;
- Generate ID-Code Schema for Item-Type-Descriptors (optional, see ref [3]);
- Determine and validate FR's with the diagram, the Equipment List, etc.⁹;
- Request for PNI [9] and/or TTT [4] via the CAD-Ticket, then obtain and distribute to DA/Manufacturer;
- Generate specific Item Lists, e.g. Equipment List, BOM for Site-Assembly, then maintain them as source data of the ITER-BOM;
- Control all IDI's under his or her responsibility with item lists. For instance:

⁹ Verification to be supported by CAD-Designers.

- Record Non-Conformity during the transportation, etc. associated with the As-Built IDI;
- Check if all physical labelling/tagging are done before the shipment;
- Control status of the IDI's, e.g. Pass/Fail/Hold at a verification test; etc.
- IO-Eng-RO's and Document Controllers to check if documents tagged with key Item-ID-Code(s).

7.1.2 Construction Team

- Generate requirements, contractual documents and/or technical specifications for logistics, warehouse and/or construction, in compliance with this procedure and the associated MQP-L3 procedures;
- Generate and approve templates for ITER-BOM's and for other specific item lists necessary for Shipping, Warehouse and Construction, e.g. Packing List;
- Accept completed ITER-BOM's at EWP-HO.

7.1.3 DA/Manufacturer

- Respecting the Quality Plan [16] and the contractual documents, e.g. PA-Annex-B, implement item identification and full traceability;
- Any item-related documents shall be tagged with the concerned Item-ID-Code;
- Send the required item lists (in PDF format), and the original Excel file (Digital) to IO-CT. If it is requested by the IO-TRO then mutually agreed with the DA, it becomes a responsibility for DA/Manufacturer to provide it;
- Generate Manufacturer Model/Part Num., MN Code Schema, and submit it to IO-CT, as necessary;
- Generate and attach MN's, SN's, Lot/Batch Num., etc. to items and the related data/documents as necessary, respecting their procedure;
- Generate Item Lists, e.g. Packing List, BOM issue for manufacturing, List of As-Built IDI's;
- Receive PNI's from IO-CT, and attach to items for delivery and/or list them in the Item Lists, e.g. List of As-Built IDI's, Packing List, as necessary;
- MN and PNI shall be linked, e.g. described together, on a physical label and in data/documents, e.g. item list, regarding each IDI;
- For physical labelling, attach Product Label/Tag, engraving, laser marking, etc. (See Appendix-A and ref [8]);
- After delivery, provide support to IO-Eng-RO for the creation of the Handover Package (HOP), especially the ITER-BOM, if the IO-Eng-RO and the DA mutually agreed;
- Support to IO-CT in case of problems. For instance, find internal documents regarding a concerned item, as necessary.

7.1.4 Project Tagging and Item-Data Administrator (Tag & Item-Data Admin)

- Create and provide new PNI responding to a CAD-Ticket by IO-Eng-RO;
- Register and maintain PNI and the attribute data in SPMAT and ITER-Catalogue;
- Generate and control TTT-Codes [4] answering to the request by IO-Eng-RO;

- Regarding FR, support IO-Eng-RO to generate diagrams and the associated Equipment Lists, Line Lists, etc., in which ITER Components are tagged with FR's;
- Define general numbering system and Item-ID-Code schema for FR, PNI and TTT-Code, as MQP-L3 documents;
- Generate ITER-BOM template for data loading on SPMAT/SPRD, supported by IO-Engineers;
- Load data on SPMAT/SPRD, or support users to load data on the database;
- Maintain item-data on SPMAT/SPRD allowing access by users;
- Organize training for ID Process;
- Consultation and/or support for users;

Note: For example, ID-Process Owner to delegate part of his or her authority to:

- Tag & Item-Data-Admin: Responsible and Accountable for the roles above;
- Status Accounting: Configuration Management Team to ensure the item-data and the process complying with MQP-Documents and other specific rules for ID Process;

7.2 Responsibility Assignment for Five Types of PA's

Responsibility assignments for five types of PA's [17] are explained.

Regardless of the type of PA, the IO-TRO shall specify all necessary works to be carried out by the DA, with the PA-Annex-B in compliance with the MQP-L3 documents, [3] , [4], [8], [9], [10] and the one for SP Data Load-2 Process [36].

General responsibilities of DA's are described in Table 1.

Table 1 General Responsibility of DA per PA-Type

Activity	BtP-PA /Supply-PA	DD-PA	FS-PA
I-a. System Design	-	-	X
I-b. Assembly & IDI Engineering Design	-	X	X
II. Manufacturing Design and Manufacture	X (Only procurement for Supply-PA)	X	X
III-a. Preparation for Construction	As required, e.g. Integration PA		
III-b. Construction	As required, e.g. Integration PA		
IV. Commission and onward	As required		

7.2.1 B-t-P PA

Table 2 shows the responsibility assignment for B-t-P PA.

Table 2 Responsibility Assignment, RASCI Matrix regarding B-t-P PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Design	I.1	Generation of ITER-BOM Templates*	S	-	S, A
	I.2	Generate FR Numbering Schema for Discipline	R,A	-	-
	I.3	Ensure all ITER Components identified and tagged with FR's	R,A	I	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	R,A	-	C

	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	R,A	C	I
II. Manufacture / Procurement	II.1	Generate all necessary MN's (linked with PNI's) [3]	A	R	-
	II.2	Agree on Product Labels/Tags, Index Num.s., other marks with Manufacturing Drawing	A	R	I
	II.3	Ensure all IDI's are planned and tagged with PNI's	A	R	-
	II.4	Affix Product Label/Tag	A	R	-
	II.5	Affix Shipping Label	-	R, A	-
	II.6	Ensure DRR Readiness	A	R	C
III. Construction		N/A			
IV. Commission		N/A			

R: Responsible, A: Accountable, S: Support, C: Consulted and I: Informed

*) Tag & Item-Data Admin to generate ITER-BOM Templates. They also support IO-Eng-RO, DA, and Construction Team throughout the process steps.

7.2.2 Supply PA

- DA shall perform the same work steps and documentation as for B-t-P PA shown in Table 2, except for manufacturing related works and the document deliverables.

7.2.3 Detailed Design, DD-PA

Table 3 shows the responsibility assignment for DD-PA.

DA/Manufacturer shall:

- Complete the assembly design and the detailed IDI design, in addition to the contents for B-t-P PA (Table 2);
- Generate BOM for Site-Assembly and Preliminary Delivery List, etc., which will be reviewed at FDR.

Table 3 Responsibility Assignment, RASCI Matrix regarding DD PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Design	I.1	Generation of ITER-BOM Templates	S	-	S, A
	I.2	Generate FR Numbering Schema for Discipline	R,A	-	-
	I.3	Ensure all ITER Components identified and tagged with FR's	R,A	C	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	(R,)A	R	C
	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	(R,)A	R	I
II. Manufacture / Procurement		All the same as for B-t-P PA			
III. Construction		N/A			
IV. Commission		N/A			

(R) represents Co-Executor.

7.2.4 Functional Specification, FS-PA

Table 4 shows the responsibility assignment for FS-PA.

In addition to the works specified for DD-PA, DA/Manufacturer shall:

- Complete the system design and the deliverables, e.g. Equipment List, Line List;
- Request for necessary FR's, TTT-Codes [4], and PNI's to IO-Eng-RO.

Table 4 Responsibility Assignment, RASCI Matrix regarding FS-PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Design	I.1	Generation of ITER-BOM Templates	S	S	S, A
	I.2	Generate FR Numbering Schema for Discipline	(R,)A	R	-
	I.3	Ensure all ITER Components identified and tagged with FR's	(R,)A	R	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	(R,)A	R	C
	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	(R,)A	R	I
II. Manufacture / Procurement		All the same as for B-t-P PA			
III. Construction		N/A			
IV. Commission		N/A			

(R) represents Co-Executor.

7.2.5 Site-Assembly, e.g. Integration PA

Table 5 shows the responsibility assignments in the construction phase, regarding two cases, a) no requirement in PA Annex-B, and b) required in PA Annex-B, such as Integration PA. If required, DA/Manufacturer shall:

- Prepare HOP, then achieve the successful HO with IO-TRO (Steps III.1 and III.2);
- Control items and generate necessary documentation until the completion of the site-assembly/installation, i.e. CCR;
- At installation of the concerned items, as required, affix ITER Component Labels (Step III.5);
- Generate As-Built documentation, e.g. As-Built Equipment List filled up with SN's (Step III. 6).

Table 5 Responsibility Assignment, RASCI Matrix in Construction

a) No construction included

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
III. Construction	III.1	Assemble EWP Handover Package, HOP including completed ITER-BOM	R, A	S	C
	III.2	Handover	R	-	A
	III.3	Load ITER-BOM on SPMAT	C	-	R, A
	III.4	Affix Warehouse Label	-	-	R
	III.5	Affix ITER Component Label	-	-	R, A
	III.6	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR's and SN's are linked	I	-	R, A

b) With construction, e.g. Integration PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
III. Construction	III.1	Assemble EWP Handover Package, HOP including completed ITER-BOM	(R,) A	R*	C
	III.2	Handover	R	R*	A
	III.3	Load ITER-BOM on SPMAT	C	C	R, A
	III.4	Affix Warehouse Label	-	-	R
	III.5	Affix ITER Component Label	-	R	A
	III.6	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR's and SN's are linked	I	R	A

*) If required with the contractual document, i.e. PA-Annex-B.

7.2.6 Commission Onwards

To be defined later, once the process is developed by the Operation and Maintenance (OM) Process.

8 Link with Other Processes

The ID Process is a cross-cutting process linked with other MQP-Processes. The link with the Operation and Maintenance (OM) Process¹⁰ to be specified in the future, as the process is defined.

Interactions with Configuration Management, CM Process

- Definition of “Controlled Items”, which include temporary tools, consumables, etc., shall be consistent with the definition in [2];
- Relationship between an item and related technical documents are the common concern [2]. Methodology of document tagging to be consistent;
- PBS-Codes as parts of FR's and GBS-Codes as attribute data shall be provided by CM Process;
- EWP-Handover is under CM Process [7].

Interactions with Design Control, DC Processes

- Implement the requirement of ID Process in technical specifications, procedures, etc. in the Design Phase;
- Part of the source data for ITER-BOM's to be generated in this process.

Engineering Data/Document Management and Gate Reviews (CM and DC Processes)

References: Configuration Management: [2] and Design Control: [23], [19]

- Implement the requirement of ID Process in each gate (See Appendix-D);
- Ensure that Item Lists including the ITER-BOM have reached the appropriate level of maturity before processing to the next level/phase of the project;
- Generation of specific Item Lists shall be planned and executed according to the Document Production Plan, DPP [DPP Procedure (TBD)];
- PLM/Matrix to control Engineering data/documents, which is the source data of the ITER-BOM, is in the scope of CM Process.

¹⁰ Necessary item-related data/documents on SP are transferred or linked to SAP Plant Maintenance (PM) for commissioning and the later.

Interactions with Quality Control, QC Process

- QC process, e.g. site inspection test, is closely related to this process, since the status of the items can be changed according to the results of tests, e.g. Factory Acceptance Test (FAT), for example “Pass,” “Fail” or “Hold”;
- Verify whether resultant reports, e.g. site inspection reports, are properly tagged with the key Item-ID-Codes.

Interactions with Software Control and Model Development, SW Process

References: CAD Manuals in the folder¹¹

- CAD-Model is also tagged with Item-ID-Codes, i.e. FR and/or PNI. Ultimately, CAD-UID's, FR's and PNI's are linked together;
- Provide CAD-UID's to be included in format of PNI tagging to some IDI's;
- Part of the data in ITER-BOM's to be exported from the CAD-Systems.

Interactions with Documents and Records, DR Process

- The ID Process requests DR Process to add some IDM and/or PLM Document Metadata, i.e. key Item-ID-Codes, FR, PNI and SN, as “tags to document.”

Manufacturing, Assembly and Installation, MA Process

References:[21] [22]

- Implement the requirement of ID Process in technical specification, procedure, etc.;
- Define the contents of the EWP-HOP [7];
- ITER-BOM is to be handed over by IO-Eng-RO, i.e. EWP-Leader ;
- Specify and request necessary attribute data included in ITER-BOM templates;
- Part of the source data for ITER-BOM's to be generated in this process.

Handling, Storage and Transportation of Materials (HS-Process)

References: [24], [25], and [26]. For DRR, [23].

- Implement the requirement of ID Process in technical specification, procedure, etc.;
- Responsible for tagging and item control, regarding logistics, warehouse and construction;
- Provide the definition of DRR and the necessary documentation [23].

Cross-Cutting Process (QA, PK and NS Process)

References: Quality Assurance: [1], [27]. Nuclear Safety: [28], [29], [30], [34] and Procurement in Kind (In-kind, i.e. PA) [17], [20]

- Define attribute data, i.e. important classification codes, e.g. PIC/SIC, PE/NPE, QC, including the selectable Code Masters, e.g. “QC-1, QC-2, QC-3”;
- Requirements for 5 types of PAs shall be consistent with this MQP-L2.

¹¹ <https://user.iter.org/default.aspx?uid=2FQDLM> (to be updated consistent with this MQP-L2)

9 Outputs (Records, Deliverables, Implementation Plans..)

Any item-related data/documents and data set in the databases shall be tagged with key Item-ID-Codes, i.e. a) Item-Type-Ref-Num, e.g. PNI, MN, b) SN and/or c) FR as necessary. Respecting this source data, the ITER-BOM is generated and loaded on SmartPlant. Output documents within ID Process are as follows.

Type of output	Format (Template, form, checklist)	Location of output	Document type	Instructions for identification of the output	Responsible for managing the output	Retention period
Completed ITER-BOM	To be provided for each technical discipline by Tag&Item-Data Admin.	PLM/Matrix	List	Tagged with EWP Code, etc.	IO-Eng-RO	Over the project lifecycle
ITER Catalogue on SPRD	N/A	SPRD	Digital Data	N/A	Tag & Item-Data Admin	Over the project lifecycle
Item Data on SPMAT	N/A	SPMAT	Digital Data	N/A	Tag & Item-Data Admin	Over the project lifecycle

Appendix-A Contents of Physical Labels

Table A-1 Minimum contents of the label

Label	By whom	When	Mandatory contents	Additional information
Product Label	Manufacturer	Before DRR	1) Title of Product, 2) Manufacture Model/Part Number, MN, 3) PNI* ³ , 4) SN/Lot Number* ⁴ , 5) Safety Classification* ⁵ , e.g. PIC/SIC, PE/NPE, 6) Quality Class.	1) Other Ref. Num., 2) Dimensions, 3) Weight, 4) Supplier, 5) Production Date (DD/MM/YY), 6) CE marking, as required.
Shipping Label* ¹	Manufacturer	Before DRR	1) Title of crate, 2) Purchase Order, PO, Contract Number, PA Code, etc., 3) Shipping/Crate Num., 4) Supplier Ref. Num., 5) MN, 6) PNI* ³ , 7) SN/Lot Number* ⁴ , 8) Safety Classification, e.g. PIC/SIC, PE/NPE, 9) From (Sender)/To (Receiver), 10) Net/gross weight, 11) Responsibility, 12) Packing Date (DD/MM/YY), 13) Shipping Date (DD/MM/YY).	1) Dimensions, 2) Other Ref. Num., 3) Quantity in the crate
Warehouse Label	IO/CST	At reception	See ref [8] (To be generated by Handling, Storage and Transportation (HS) Process)	Always generated and affixed to an item by IO-CT
ITER Component Label* ⁴	Construction Team and Contractor	Before CCR	1) Title of ITER Component, 2) FR, 3) Safety Classification, e.g. PIC/SIC, PE/NPE, 4) QR Code implying relevant attribute data.	See the successful implementation by PBS-65 ref [5]

*1) Accompanying signs, e.g. sign of handling precaution during transportation.

*2) PNI can be accompanied by Item-Type-Descriptor (in parentheses).

*3) If fully traceable, SN/Lot Number is not always required to be included in a label.

*4) Dedicated PE/NPE label to be provided with [A1] in addition to the ITER Component Label. If the contents complying both the requirements, the physical labels can be merged.

*5) If over qualified component is installed as an ITER Component of the lower classification, then delete this from the Product Label at the installation, because the correct classification code is presented in the ITER Component Label. For example, a valve qualified as SIC-1 to be installed as a SIC-2 ITER Component.

[A1] Template for PE/NPE Name Plate [Y3AZ83]

Appendix-B Contents of Specific Item Lists

Table B-1 Contents in Specific Item List for Engineering Purpose

	1) Equipment List, Line List, etc. [13]	2) BOM for Site-Assembly [12]	3) List of As-Built IDI's in Quality Control Record	4) List of Deliverables [14]	5) Packing List[14], [15]
Contents in the list of items	- Title of ITER Component; - Functional Reference, FR; - PNI, if identified; - Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; - Interface/Layout, e.g. GBS; - System/Plant Functional Property, such as Operation Pressure; - Reference Documents, Drawing, Diagram, e.g. GA, PFD. Additional fields, as required.	- Title of Item; - Part Number of ITER, PNI; - FR*, if already decided; - Quantity and the Units Of Measure, UOMs; - Physical properties, e.g. dimensions, weight and the UOMs; - Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; - IDI functional properties, e.g. design pressure; - Reference documents, e.g. Technical Specification, Drawing. Additional fields, as required * FR shall be in the drawing.	- Title of Item ; - PNI ; - SN ; - Manufacturer Model/Part Number, MN, if any; - Quantity and the UOM; - IDI Physical Properties, e.g. dimensions, weight and the UOMs ; - Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; - Reference documents, e.g. relevant NCR (as necessary). Additional fields, as required.	- Title of item; - PNI; - Quantity and the UOM; - Physical properties, e.g. dimensions, weight and the UOMs; - Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; - Reference documents. Additional fields, as required	- Title of Item; - PNI ; - SN ; - Manufacturer Model/Part Number, MN , if any; - Quantity and the UOM ; - IDI Physical Properties, e.g. weight and the UOM's; - Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; - Reference documents, e.g. relevant NCR (as necessary). Additional fields, as required
General data in the title block	(Sub-)System Name, PBS-Code, GBS-Code, RO, etc.	PBS-Code, GBS-Code, FR, PA / Contract-Code, RO, etc.	PBS-Code, PA/Contract-Code, RO, etc.	PBS-Code, PA/Contract-Code, RO, IPL, etc.	PBS-Code, PA/Contract-Code, RO, Inter-Project Links (IPL's), etc.
Note		Sub-set of a BOM for certain Construction Work Packages (CWP) is sometimes required. This BOM shall list all IDI's described in the Assembly Requirement Drawing(s) and (Multi-) Component Drawing(s) [11].	SN as necessary.	The contents of the Planned Delivery List at MRR can be different from the ones in the Preliminary Delivery List. For instance, items can be split for transportation reason. Planned Delivery List shall describe both PNI's and the corresponding MN's.	SN as necessary.

Appendix-C Summary of Requirements for DAs within the ID-Process

C-1 General Requirements common to all PA Types

#	General Requirement for DA	Remarks	At latest
RG1	Items and the related data/document shall be fully traceable respecting PA-Annex-B and the Quality Plan, QP.	At minimum, any document by DA/Manufacturer shall be tagged with MN (and SN). Tagging with PNI <u>in addition to MN</u> is preferred.	MRR (for Manufacturing Design) DRR (for As-Built)
RG2	Tag all the deliverables, e.g. hardware, software, data/documents, in MRR or DRR, as specified within this procedure and other PA documents.	All deliverables shall be properly tagged with Item-ID-Code,. BOM for Shop-Assembly to be generated. However, these are out of scope of ID-Process.	MRR(for Manufacturing Design) DRR (for As-Built)
RG3	Regarding any type of Item List as PA Deliverable, agree on the contents and the format with IO-TRO.	IO-CT should provide the templates to specify the requirement.	PA Signed
RG4	Submit MN Code Schema as FYI (optional)		MRR
RG5	Submit original Excel files of Item Lists in addition to the official deliverables, as necessary (as mutually agreed).	The Excel files are exception from responsibility	Any Time
RG6	Support IO-TRO in order to prepare EWP-HOP for construction. Consulted with IO-TRO, as the responsible for Manufacturing Design and the Manufacture.	As necessary	Any time

C-2 Specific requirement for B-t-P PA

#	Requirement for DA within ID Process	Remarks	At latest
RM1	Agree with IO-TRO on Product Labels/Tags regarding the locations, the materials, the methods of affixation, etc., on the Manufacturing Drawings.		MRR
RM2	Agree with IO-TRO on tagging to interface with index number, etc., on the Manufacturing Drawing		MRR
RM3	Submit Planned Delivery List in compliance with the items and the quantities specified in PA-Annex-B	To each item, i.e. IDI, both PNI and Manufacturer Model/Part Number (MN) should be tagged to. The quantity and other attribute data, e.g. PIC/SIC, PE/NPE, QC shall be described.	MRR
RM4	Acquire additional PNI from IO-TRO, if new IDI is identified in the Manufacturing Design, etc.	Request for PNI and Cataloguing via CAD-Ticket System is only entitled to IO-TRO [9].	MRR
RM5	Product Label: Physical labelling/tagging on each as-built (As-Manufactured) IDI.		DRR
RM6	Affix necessary marks/signs, e.g. CE Marking, lifting/handling, Centre of Gravity, to the product, as required.		DRR
RM7	Submit a list of As-Built IDI's as a part of As-Built Quality Control Records.	To each listed item, PNI, MN and SN/ Lot Num. shall be tagged and linked with. Other as-built data, e.g. Ref. Num. of relevant NCR, check for	DRR

		physical labelling, should be included.	
RM8	Submit Packing List.	PNI, MN and SN/Lot Num. and quantities and attribute data, e.g. Shipment, Crate shall be documented.	DRR
RM9	At the time of packaging, cooperate with IO-TRO for “kitting” taking into account of the material handling on site and the construction process.	For instance, instead of tagging small items, e.g. bolts, nuts, with the PNI’s, affix one PNI to the Kit made up with all the necessary items.	DRR
RM10	Affix Shipping Labels to shipping crates.	Include all necessary information, e.g. PIC/SIC, PE/NPE	DRR

C-3 Specific requirement for Supply PA

Basically, the requirement is the same as for B-t-P PA. Manufacturer Model/Part Number (MN) is already determined at the Purchase Order (PO), DA to use PNI’s in the physical labels, the documentation, etc., associated with the MN’s.

C-4 Specific requirement for DD PA

In addition to the As-Built PA requirements, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RD1	Identify all IDI’s to deliver, and tag them with PNI’s	Request PNI to the IO-TRO	FDR
RD2	Tag all the engineering data/documents with PNI and/or FR.		FDR
RD3	Tag to CAD-Data, i.e. CAD-UID with FR’s and/or PNI’s, as necessary.		FDR

C-5 Specific requirement for FS PA

In addition to the DD PA requirement, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RF1	Generate FR Numbering Schema within the scope of the PA.		PDR
RF2	Identify all ITER Components and tag them with the FR’s.	Request necessary TTT-Code to IO-TRO	FDR
RF3	Generate data/documents, e.g. diagrams, Equipment List, to validate the FR’s upon their approvals.	Sign-off authorities are in [18]	FDR

C-6 Specific requirement for PA Including Site-Assembly, e.g. Integration PA

If site-assembly/installation by DA is included in the PA scope, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RC1	Assemble EWP Handover Package (HOP) including completed ITER-BOM*.		HO
RC2	Handover*		HO
RC3	Support to load ITER-BOM on SPMAT.	[36]	HO (at latest CRR)
RC4	Affix ITER Component Label.	[8]	CCR
RC5	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR’s and SN’s are linked.		CCR

*) If required with the contractual document.

Commissioning onwards: TBD

Appendix-D Checklist at Each Control Gate/Point

Table D-1 shows a checklist associated with Control Gates/Points, where completeness, consistency and conformance of the tagged items and the data/documents are ensured.

Table D-1 Check List

	Gate	Questions	Check	Reference		
	General (at each Control Gate/ Point)	Are all item related data/documents tagged with Item-ID-Code and fully traceable? (Including items described in the data/documents, e.g. Drawing, Diagram, 3D Model)				
		Are all the deliverables of ID Process consistent with other data/documents, i.e. “the source data”?				
Before SP Data-Load-1	PDR	Are major ITER Components tagged with FR’s in Diagram, GA, Equipment List, etc., respecting the developed discipline ID-Code Schema?		[19]		
	FDR	Are all ITER Component tagged with FR’s?				
		Are all IDI’s identified and tagged with PNI’s?				
		Are IDI’s in CAD-Data tagged with FR and/or PNI?				
	B-t-P PA signed	Are all IDI’s to be delivered identified within PA-Documents (as the Preliminary Deliverable List)?				
	MRR	Are all items tagged with MN’s, then IDI’s, which are selected among the items, tagged with PNI’s in item lists, e.g. BOM, enclosed in the Manufacturing Dossier?		[21]	Quality Plan, QP [16]	
Are necessary IDI-Types tagged with PNI’s loaded on SPMAT/SPRD? 						

Appendix-E Instructions for Recovery from Contingency Cases

The basic principle of recovery is:

- Recovery action is under the responsibility of the IO-Eng-RO, namely the TRO for the PA deliverables. As necessary, DA is requested to support;
- When there is a non-conformity to the PA-Annex-B and/or the Quality Plan, e.g. missing identification, the DA is subjected to raise an NCR, and to respect the subsequent decision;
- If a problem is due to the insufficient requirement in the contractual document, e.g. PA-Annex-B, the IO-Eng-RO shall take all the responsibility to recover;
- Non-Conforming Items arriving on site are immediately isolated in “Quarantine” (a designated area in the warehouse).
Note: This does not mean an accepted non-conformity, but newly detected one.
- Technical recovery work shall not be requested of the warehouse staff;
- IO-Eng-RO shall recover Item-Data problems supported by Tag & Item-Data Admin;
- Together with the recovery actions below, the related data/documents should be updated, so as that the consistency is maintained.

Four contingency cases are described below.

E1 Delivery without PNI

- Obtain PNI(s) via CAD-Ticket System respecting [9], then register the IDI in SPMAT;
Note: The MN and the newly obtained PNI shall be correlated in SPMAT and/or in the list of As-Built-IDI's, in order to make the item-data/documents fully traceable;
- Recover Physical Labels/Tags as described in E2, below.

E2 Missing Physical Label/Tag or Missing Data on Label/Tag

- Produce Physical Labels including the PNI's, then affix them in the adequate positions in an appropriate manner;
- If mutually agreed between IO-Eng-RO and Construction Team, recovery with ITER Component Label including the information of the product, can take place at a later date, in which case a temporary label/tag is required.

E3 Inconsistency between Enclosed IDI's and Packing List

- To be decided by HS process;
- DA/Manufacturer shall recover the data/documents including ITER-BOM (if already loaded on SPMAT);
- If needed, the Product Label/Tag to be corrected respecting the decision of the NCR;
- Tag & Item-Data Admin to correct the data on SPMAT, as necessary.

E4 Imperfection of ITER-BOM for PNI Request and/or SmartPlant Data Load

- Submit the missing data via CAD Ticket system, then communication with Tag & Item-Data Admin, as necessary;
- Respect an instruction given by Tag & Item-Data Admin.

Note: If discrepancies happen between ITER-BOM and the source data, they shall be promptly controlled and recovered by the IO-Eng-RO.



IDM UID

28QDBS

VERSION CREATED ON / VERSION / STATUS

27 Nov 2024 / 5.1 / Approved

EXTERNAL REFERENCE / VERSION

MQP Level 3**ITER Numbering System for Components and Parts**

This document describes the numbering systems to be used to define the identifiers for components and parts in the ITER project, and thus rigorously ensuring the traceability of each item throughout the ITER Project life cycle.

<i>Approval Process</i>			
	<i>Name</i>	<i>Action</i>	<i>Affiliation</i>
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#drn#

Change Log			
ITER Numbering System for Components and Parts (28QDBS)			
Version	Latest Status	Issue Date	Description of Change
v1.0	Approved	09 Oct 2007	This procedure specifies the structure of ITER numbering for parts and components.
v1.1	Signed	23 Jun 2008	This procedure specifies the structure of ITER numbering for parts and components.
v1.2	Signed	11 Jul 2008	This procedure specifies the structure of ITER numbering for parts and components.
v1.3	Approved	04 Sep 2008	This procedure specifies the structure of ITER numbering for parts and components.
v2.0	Approved	26 May 2011	Incorporated the definition of part number and revised ITER PBS document
v3.0	Revision Required	23 Aug 2018	v3.0 include : Detailing of Functional Reference usage Introduction of Additional Referencing Capability : Component in Component concept Instrumentation Referencing Naming of Interface locator/ Nozzle /Spool / Part Tag Detailing of Part Number of ITER : PNI Encoding of various Type of Part Number of ITER Classification of PNI within ITER Material Database Strategy for custom fit marking on Physical Items (SN) Relationship between FR/PNI/SN Guideline for Referencing
v3.1	In Work	11 Oct 2018	1) General, FR “System Component” tagged with FR. Note that the word “Component” was used for various meanings in the previous version. 2) General, TTT In Appendix-G, TTT-codes are grouped into 1) Process Functional and 2) Non Process Functional 3) Page 3, Foot note Definition of Individually Distinguishable Item, IDI is added 4) General Main context is shortened. Basic concept, formats, and flowchart are the main elements in it. All supplemental codes are shifted to Appendix-D 5) PNI Format, Page 6, Para. 6.1 Unified format of PNI, “IXXXXXXX” is only explained in the main context 6) Page 7 3BM-diagram associated with Control Gates is added. 7) Pages 7 to 10 Flowchart and the process steps are describes associated with the Control Gates 8) Page 11, Sec. 8 Responsibility Assignment is simplified associated with SOA [2EXFXU] 9) Appendix-A All instructive parts for FR are described in Appendix-A. The word “Implied Item” is discarded. In contrast, some explanations for PBS-codes, FR’s (parent & child) , allocation of delivered item to PBS-L3 or FR, etc. are explained. 10) Appendix-B All instructive parts for PNI are described in Appendix-B. PNI’s generated by CATIA/Enovia or Smart Plant are explained. Other Frequently Asked Questions (FAQs) are answered 11) Appendix-B, B2.3 (and D9) MN Manufacturer Part Number, MN is defined clearly

			12) B2.4 to B2.6 Granularity of PNI and grouping, i.e. Kitting taken into account of site-assembly process clarified. 13) B2.8 Spare Spare is moved to Appendix B 14) B2.9 Version control of design by PNI associated with Tech Spec (and/or Drawing) No. and the rev. num. is explained 15) Appendix-C Clear diagram for Tagging Construction Shite and Warehouse. Fig. 14 was difficult to understand in the previous version . 16) Appendix-D All supplemental codes are moved into this Appendix-D (respecting KBR's comment) 17) D10 The formula of "PNI = Commodity Code + Dimensions" is added. 18) Appendix-G TTT-code is explained in short. The detail is to be defined in [2FJMPY] at next revision. 19) Appendix-H All defined ID-codes are summarized in one page.
v3.2	Approved	11 Oct 2018	Some figures are broken at the previous IDM load.
v4.0	In Work	08 Sep 2020	As per approved MQP doc request https://user.iter.org/?uid=3JGHT5 there are no changes to the document but this review is to have DAs in the loop for impact assessment and make the documents Annex A PA AD through the MPA.
v4.1	Signed	15 Sep 2020	This version is simplified in order to be integrated into the Multi-Party agreement making this document applicable to all PAs: - Removal of the Roles and responsibilities and workflow for the sake of clarity, as they are completely described in the already applicable L-II procedure: U344WG - English polishing without changing any requirement / feature of the document
v5.0	Approved	16 Dec 2020	As per approved MQP doc request https://user.iter.org/?uid=3E9FEF the changes are: This document is aimed at becoming a PA-AD. Before doing so 2 issues were identified: - The workflow defined in this document is redundant and obsolete as opposed to the workflow described in the L2 procedure U344WG, which is already a PA-AD. - As a consequence to the workflow redundancy, the responsibilities are also redundant and obsolete. - Some improvement of the English (polishing) are required.
v5.1	Approved	27 Nov 2024	As per communication CQ6BZ9 and tracked changes version the changes are: - Reorg change: responsibility to generate PNI by ESD/DO - IO Eng. RO replaced by IO System RO - Minimum alignment with MQP template 438T76 - Some minor corrections

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1 Purpose

This document describes the numbering systems to be used to define the identifiers for components and parts in the ITER project, and thus rigorously ensuring the traceability of each item throughout the ITER Project life cycle.

2 Scope

This document is a Level-3 procedure under the Level-2 procedure for Identification and Controls of Items [U344WG]. This document is applicable to all components and parts designed and procured for the ITER project.

The scope of this document is to establish tagging notions for:

- **System Components** tagged with Functional Reference, FR
- **Type References** tagged with Part Number of ITER, PNI
- **Physical Items** tagged with Serial (/ Lot/ Batch) Numbers, SN

The ID-code schemes described in this document address the following identifiers (Three-Ball Model):

1. **FR**: to uniquely identify all **System Components** present in the ITER system physically, geographically, in diagrams and/or in 3D and control rooms on the ITER site.
2. **PNI**: to identify all **Type References** of items designed, manufactured (or procured), assembled, commissioned and subject to maintenance on the ITER site.
3. **SN**: to identify individual **Physical Items** manufactured and/or procured.

3 Definitions and Acronyms

3.1 Acronyms

Acronym	Definition
3BM	3-Ball Model
CCR	Construction Completion Review
COTS	Commercial Off-The-Shelf
CRR	Construction Readiness Review
DA	Domestic Agency
DRR	Delivery Readiness Review
EDB	Engineering Database
Eng	Engineering
FAQ	Frequently Asked Questions
FDR	Final Design Review
FR	Functional Reference
HO	Handover
IDI ¹	Individually Distinguishable Item
IEEE	Institute of Electrical and Electronics Engineers
ISA	International Society of Automation
MN	Manufacturer Part Number
MRR	Manufacturing Readiness Review

¹ IDI: Item (to be) delivered and/or handled by IO or any other item designated by IO-CT subject to control. All IDIs shall be tagged with PNIs

PBS	Plant Breakdown Structure
PDR	Preliminary Design Review
PIC	Protection Important Component
PID	Piping and instrumentation diagram
PLM	Product Lifecycle Management Software
PNI	Part Number of ITER
RE	Responsible Engineer
RO	Responsible Officer
SN	Serial Number
TTT Code	Commonly used for the Function Category Designator

4 References

4.1 Applicable Documents

- 1) Procedure for Identification and Item Control [U344WG]
- 2) Sign-Off Authority for Project Documents [2EXFXU]

4.2 Reference Documents

- 1) ITER Plant Breakdown Structure [28WB2P]
- 2) ITER PBS Structure [2FBMWF]
- 3) ITER Function Category and Type for ITER Numbering System [2FJMPY]
- 4) Function Category Designators [43WDW9]
- 5) ISA 5.1-2009: Instrumentation Symbols and Identification
- 6) IEC 81346-2:2009: Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes
- 7) Work Instruction for Creation of Part Number of ITER, PNI and Cataloguing [UYGU3S]
- 8) Procedure for Labelling on Physical Items [VYJ7U2]
- 9) Signal and plant system I&C Variable Naming Convention [2UT8SH]

5 General Principles

The ITER Numbering System follows several key principles:

- It is based on the concept of Three-Ball-Model [U344WG];
- An item in any situation, e.g. as-designed, as-delivered, as-installed, shall be tagged with one or more 3-Ball-Model (3BM) identifiers.
- The 3BM identifiers (FR, PNI and SN) of an item identify it 1) as a component in the ITER System called **System Component**, 2) as a design solution of the item called as-designed **Type Reference**, and 3) as a manufactured and/or procured item called **Physical Item**;
- In addition to each identifier 1) to 3), there may be supplementary identifiers as shown in Appendixes;
- The requirements for each identifier are as follows;
 - FR (Functional Reference):
 - FR shall be used to identify a single System Component in a unique location in the ITER facility.

- FR shall be determined for items in accordance with the following criteria:
 - Functional items of a process appearing in a diagram and/or on the actual control monitor screens, e.g. control valves;
 - Items subject to regular inspection, maintenance, etc.;
 - Items that specifically need to be identified in their location of the ITER system, e.g. a custom-machined shim

PNI (Part Number of ITER):

- Any item or group of items (e.g. kit of items) delivered to the ITER site shall be identified and tagged with a PNI. They are called Individually Distinguishable Items (IDIs);
- An item without a PNI shall not be issued from the warehouse;
- All items identified with PNIs shall be registered in the “ITER Catalogue [UYGU3S],” from which design specification of an item of interest can be found;
- Physical Items tagged with the same PNI shall be interchangeable;
- PNI shall be controlled by IO-CT in a centralized manner to ensure the quality of this key identifier.
- PNI shall be always provided to, DA, Manufacturer, etc. by IO-CT.
- Since a PNI identifies a design solution of the item, the version of the design solution shall be controlled with version numbers of the Tech. Spec., the Drawing and/or even the Engineering Dossier;

SN (Serial Number):

- IDIs delivered to the ITER site shall be identified with SN (or Lot/Batch Num.);
- Items without SN shall not be delivered to the ITER site;
- SN, Lot Num., etc., are at the discretion of the manufacturer.

- All 3 identifiers shall be alphanumerical codes using uppercase letters and/or western style numbers.

For further understanding, detailed explanations of FR, PNI, and SN and other identifiers as well as the use cases and the Frequently Asked Questions can be found in the various Appendixes.

6 ID-Code Schema – Format -

6.1 Functional Reference, FR

FR is encoded with 12 or 13 alphanumeric uppercase characters, split into three fields separated by hyphens:

Functional Reference														
P	P	P	P	P	P	-	T	T	T	-	N	N	N	N
PBS-L3 Code						TTT-Code				Index Number				

The three consecutive elemental-codes are described below.

6.1.1 PBS Code, PPPPPP

- It is the PBS Level-3 (L3) code without the dots (.).

6.1.2 Function Category Designator, TTT-Code

- This identification field is a short field build of 2 or 3 uppercase alphabetic letters (or, under specific conditions, 2 uppercase alphabetic letters and one digit);
- The possible values of the Function Category Designators (e.g for pumps, tanks etc.) are listed in [\[43WDW9\]](#), and shall strictly be used to define the FR;
- MQP document [2FJMPY] describes TTT-code and the creation process.
(See Appendix-G, also.)

6.1.3 Index Number, NNNN

- This is a 4-digit western-style number between 0001 and 9999;

Depending on the nature of each system (process centric, mechanical centric or civil engineering centric), the system RO shall establish and document the numbering scheme.

6.1.4 Example

Functional Reference													
3	1	C	R	C	P	-	P	K		-	0	0	1 2
PBS Code L3 for Cryostat Cryopump						TTT for Cryopump				Index Number, "12"			

6.2 Part Number of ITER, PNI

PNI identification shall be done as early as possible after the Preliminary Design Review (PDR) and it becomes mandatory before Manufacturing Readiness Review (MRR).

PNI format consists of the prefix letter "I" followed by 8 alphanumeric characters:

I	X	X	X	X	X	X	X	X
Prefix "I"	8 alphanumeric characters							

There are two IT systems (CATIA/Enovia and SPMAT) that can generate the PNIs depending on the nature of Type Referenced item:

PNI generated and catalogued by CATIA/Enovia (and CADENAS²)

- The format of PNI for mechanically designed Type References (design solutions) is shown below;
- CAD-Uid consists of 6 alphanumeric characters following the prefix, "I00."

I	0	0	A	A	A	A	A	A
Prefix "I"	"00" (numeric)		CAD-Uid 6 alphanumeric characters					

PNI generated and catalogued by Smart Plant

- The format of PNI for Type References (design solutions) in SPMAT is shown below;
- For piping components designed with PDMS (AVEVA)³, this format of PNI is mostly used too.

² <https://www.cadenas.de/products>

³ https://www.aveva.com/en/Solutions/Product_Finder/AVEVA_Everything3D/

I	N	N	N	N	N	N	N	N
Prefix "I"	8 numeric characters							

The generation of the PNI and its delivery to the users are the responsibility of /ESD/DO. Therefore, users don't have to be concerned about the various formats. They just need to request the necessary PNIs via the CAD-ticket system and use them [UYGU3S] once obtained.

6.3 Serial Number, SN

- There is no imposed format. SN, Lot Num., etc., are at the discretion of the manufacturer;
- This identifier will be a SN, a batch number or a lot number, depending on whether a single individual product (SN) or a set of them (batch, lot) is being identified;
- The manufacturer will ensure traceability of the manufacturing with this SN and maintain associated records related to the manufacturing, the testing and the inspection (e.g. Mill certificates, Test reports, As-Built Drawings).

7 Flow Chart

The full flowchart for the creation of identifiers during the items lifecycle is defined in [U344WG]

8 Responsibilities for Tagging Timeline

The responsibilities for the creation of identifiers during the items lifecycle are defined in [U344WG]

9 Interactions with Other Processes

9.1 Outputs from Other Process

CM Process to provide the set of PBS codes:

1. [ITER_D_28WB2P - ITER Plant Breakdown Structure \(PBS\)](#)
2. [ITER_D_2FBMWF - ITER Plant \(PBS\)](#)

9.2 Inputs to Other Processes

Identification codes, the rules and the processes are applicable for any other MQP Processes.

For instance, for Software Control and Model Development, SW-Process refers to this document in following documents:

1. [ITER_D_24SNC9 - CAD Manual 09 - Drawing Best Practices](#)
2. [ITER_D_35CY6V - CAD Manual 14 - Diagram Guidelines](#)
3. [ITER_D_R7SAGV - 1 - How to use SSD](#)
4. [ITER_D_3434CN - 07. SSD PFD Application Presentation](#)
5. [ITER_D_33JVK9 - 10. SSD P&ID Application Presentation](#)
6. [ITER_D_UHR2AY - Management of Functional References in CATIA for Plant Components](#)
7. [ITER_D_6T9JVL - How To FILL FUNCTIONAL REFERENCE \(PPPPPP-TTT-NNNN\)](#)

10 Records

The execution of this document requires the following outputs:

Type of output	Format (Template, form, checklist)	Location of output	Document type	Responsible for managing the output	Retention period
FR	PPPPPP-TTT-NNNN	ITER Centralized Material Database Including CAD Authoring Tools	Diagrams, 3D Models, Drawings, Item Lists, etc.	CID and IO-System RO	historical meta data / till dismantling
PNI	IXXXXXXXXX	ITER Centralized Material Database Including CAD Authoring Tools	3D Models, Drawings, Item Lists, etc.	CID, and IO-System-RO	historical meta data / till dismantling
SN	No specific format	ITER Centralized Material Database	Item Lists (As-Built)	DA / Manufacturer (IO-System RO)	historical meta data / till dismantling

Appendix-A Instruction for FR

A1 Examples and Use Cases of FRs

Example of FR is shown below. Combining PBS-L3 code, TTT and Index Number, necessary FR is created.

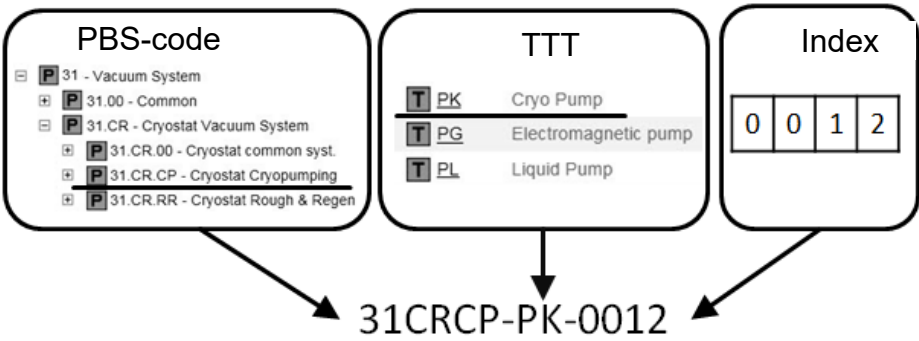


Figure A1 FR for Cryo Pump No. 12 of the Vacuum Cryostat Cryopumping sub-system

On Diagrams

The following snapshot shows a portion of a PID belonging to PBS level 3 76PHVV:

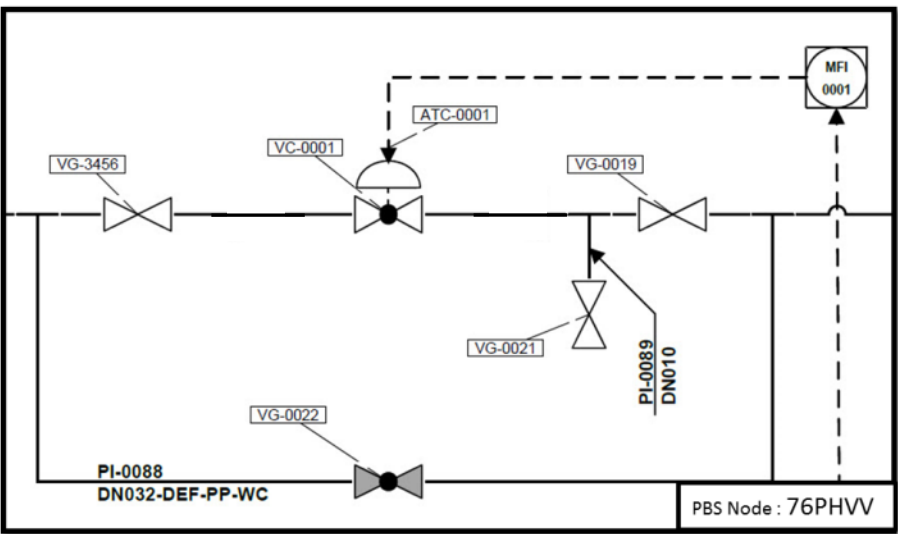


Figure A2 Label for FR on Diagrams

PBS level 3 is defined in the Diagram title block.

All System Components shown in the diagram belong to this PBS unless recalled from another PBS for interfacing. As such, all System Components in this diagram have a shortened label for their FR omitting the PBS Identifier. The label for the Piping Line, Ventilation Duct or Cable is made of the FR, followed by properties such as piping specification or fluid type.

On Layout Drawing and GA

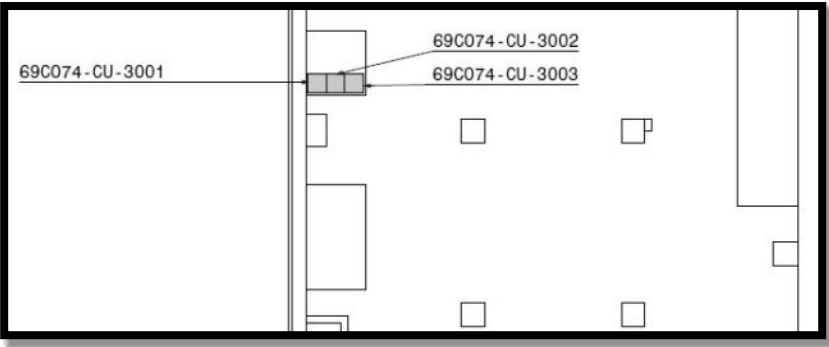


Figure A3 Label for FRs on Layout Drawing

The complete FR shall be displayed. A label with the complete FR followed by properties (such as PIC value) can also be used.

On Mechanical Drawings

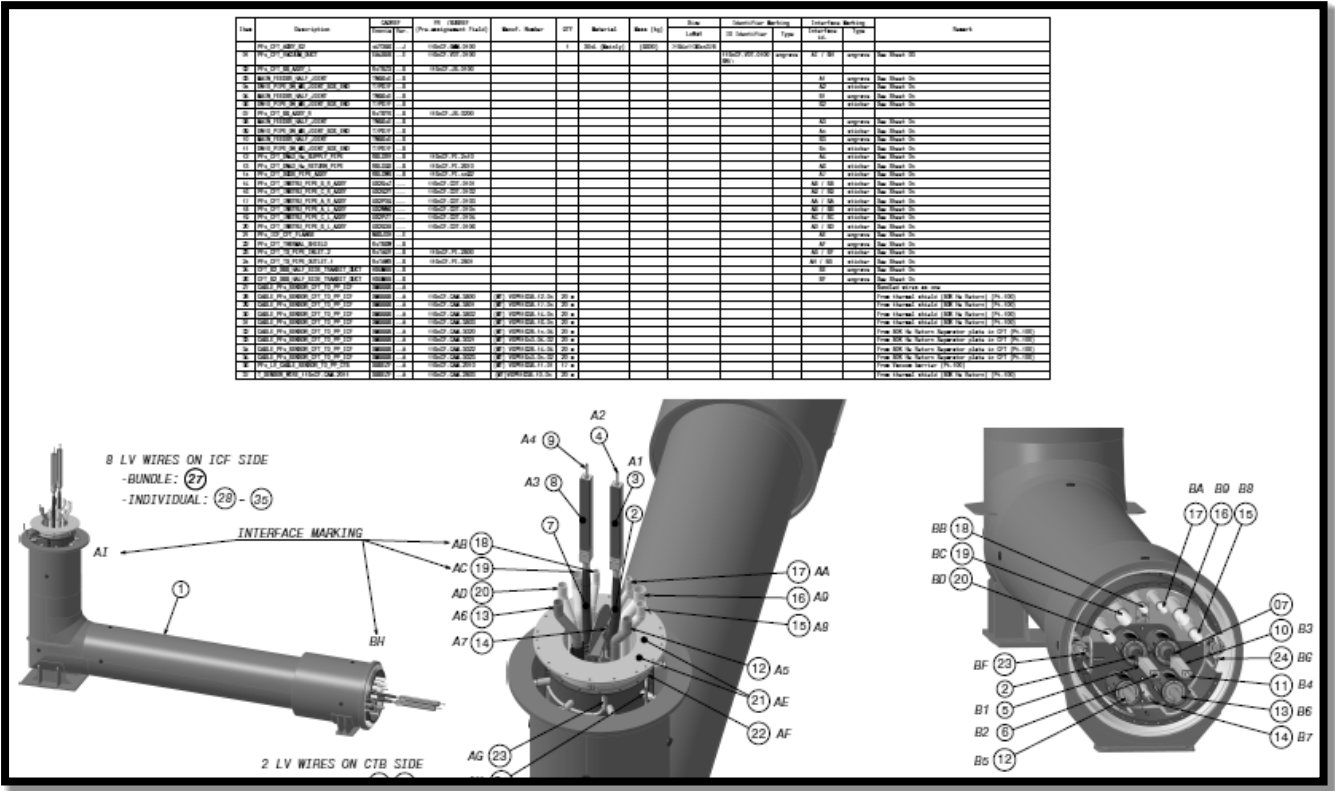


Figure A4 Callout for 3BM-Identifiers on Mechanical Identification Drawing

In a Mechanical Design, some Assembly Drawings shall be used to provide the FR, PNI, CAD part Name and Interface locators using call-outs and tables. In this example, since Cryostat Feedthrough (CFT) of PF4 Feeder is a unique Process-Functional Complex Component, several FRs are tagged to the items before installation.

Refer to Appendix-E for examples of identification.

A2 FAQ for FR

In paragraphs A2.1 to A2.4, additional explanations for FRs are given.

A2.1 Item Tagged with FR - Envelope of System Component -

- A System Component, which is a functional and/or component of interest to IO in the ITER System, is tagged with Functional Reference (FR). The FR is its unique “address” within the ITER System from functional (not geometrical) point of view;
- FRs appear in diagrams, e.g. P&ID, layout drawing, 3D CAD models, tagging pipe, valve, fluid equipment, instrumentation, cubicle, transformer, etc. ;
- Some non-process-functional components, e.g. Embedded Plates, Assembly Platform are also tagged with FRs;
- A FR can also tag System Component physically made, in 3D Model, in drawing, etc.;
- The envelope of FR is difficult to determine because FR may tag an “abstract” item on Diagram and/or Control / Monitor Screen. In addition, FRs do not exhaustively tag all items composing the whole ITER system. Finally, many assembled parts are not tagged with FR (See A2.2);
- Consistency between the Diagram, the 3D CAD design and the physical item is necessary but the envelopes of the 3D model and the actual item do not need to be determined accurately.

A2.2 PBS Level-1 to 3 Codes and FR

Relationship between PBS Level-1 to 3 Codes and FR is explained here.

- FR is equivalent to PBS-L4 code, therefore a System Component tagged with FR is associated with the parent PBS-L3;
- Figure A5 shows the hierarchy structure between PBS-L1 to 3 nodes and FRs;
- FR is recognized as PBS-L4 code, but its nature is not the same as PBS-L1 to L3;
- The summation of PBS-L1 nodes is equal to the “ITER System”;
- Similarly, the summation of PBS-L2 nodes or PBS-L3 nodes is also equal to the “ITER System.” Consequently, PBS-nodes are always “exhaustive”⁴;
- In contrast, since FRs tag only selected “System Components,” the summation of all FRs does not represent the “ITER System”.

The boundary between PBS-nodes are clear because responsibility assignment shall be done with Interface Control Document and Interface Sheet (ICD/IS). In addition, each CAD model shall be tagged with PBS-code. On the other hand, FR is abstract, because it is extracted from a diagram as a “symbol”. Therefore, to define an envelope of FR exactly is not a reasonable effort.

⁴ The reality of the current PBS code tree is not the same as presented in this figure. Criteria for the individual levels are not always System / Sub-System / Loop or Assembly, at present.

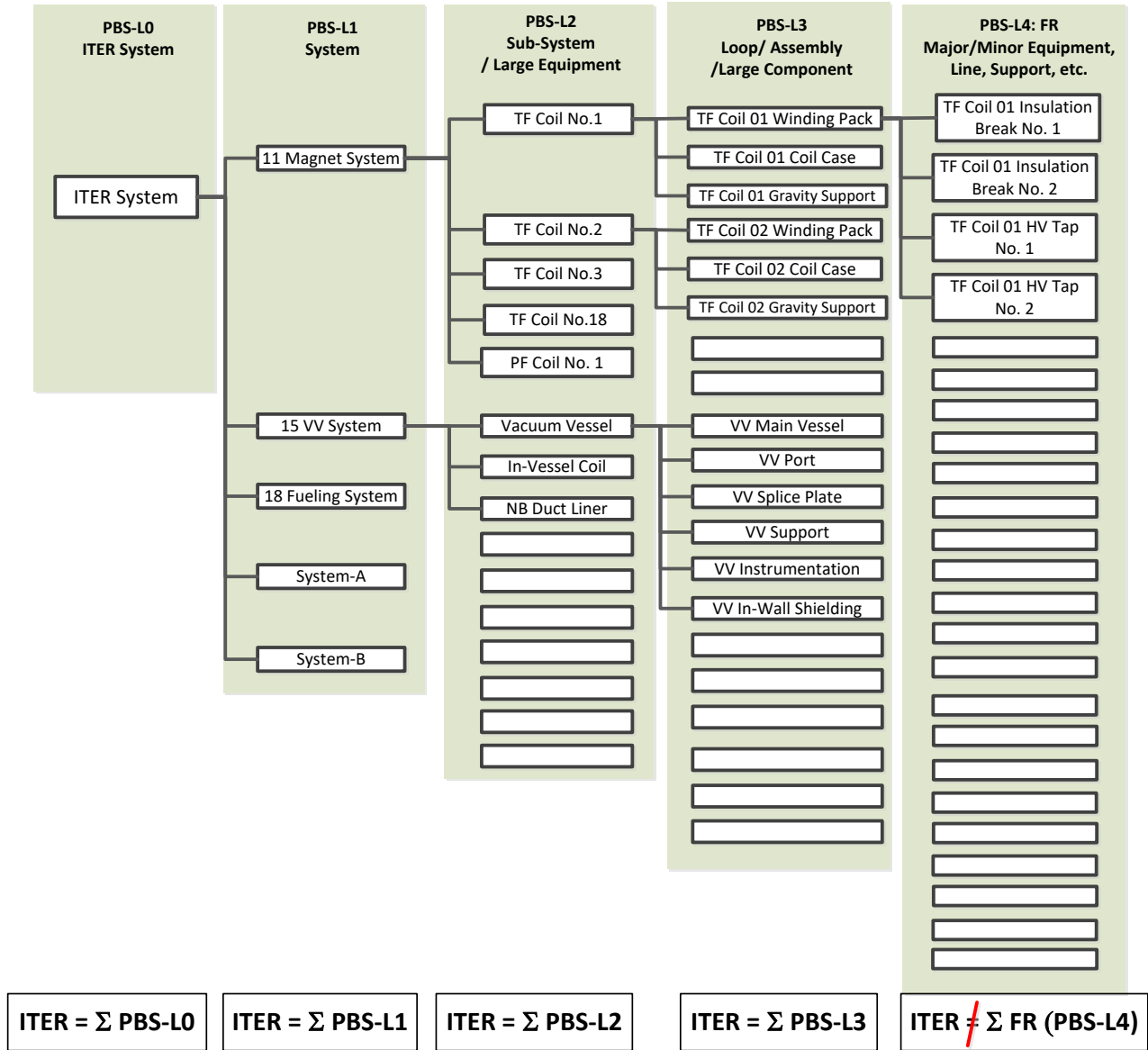


Figure A5 Hierarchy structure of PBS-L0 to L3 codes and FRs⁵

A2.3 Parent and Child FRs

An enclosure is identified with a FR as a single System Component which contains other System Components. Such Enclosing Component is called “Complex System Component”. The TTT-code entails the *Enclosure* function.

It is highly recommended to avoid deep parent-child hierarchy structure of FRs, except for complex cubicle infrastructure.

In Figure A6, the FR of the complex system component (26CVDL-SFU-1100) includes the beam structure and all the components attached to it (equipment, piping parts, etc.).

The complete skid will be tagged with the FR given to the enclosure. The components defined within the enclosure will also be tagged with their own FRs.

⁵ Different logics of coding schema are mixed up. Some improvement without significant impact is required.

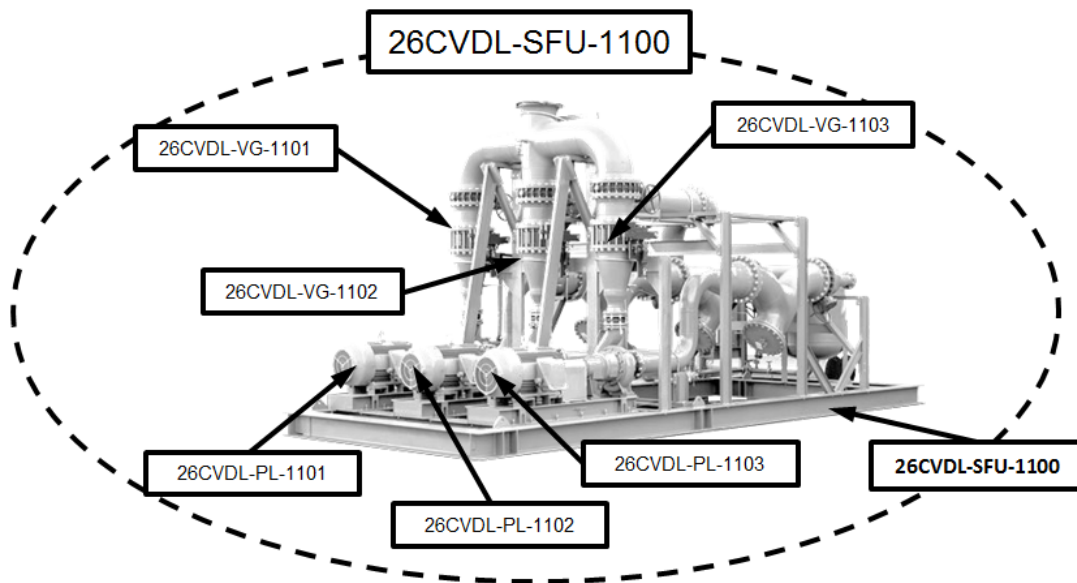


Figure A6 A Plant enclosure and its members in piping

Table A1 Sample list of TTT usable for Complex System (enclosure) Component

TTT	Title	Family	Description
GMM	General Mechanical Module	Mechanical	A mechanical structure either made of beams or panels which contain other equipment. Mechanical modules are used either to simplify logistics, or ease assembly or for constraint relative to protection of included components within.
SFU	Skid Fluid Unit	Fluid	A Skid Fluid unit is a secondary structure which embeds a set of fluid component to achieve a given function. It is delivered mounted.
GB	Glove Box	Fluid	Gas-tight box mostly made of transparent synthetic material in which certain radioactive substances can be handled by means of gloves reaching into the box.
CU	Cubicle	Electrical	

A2.4 Allocation of Delivered Item to FR – Installation -

In Figure A7, correlation between PBS-L1 to L3 nodes and FR (Equivalent to PBS-L4) is described. Items are delivered and then assembled or installed in a certain location of the ITER system (PBS-L0). This story can be named “As-delivered item is allocated to FR.”

Originally, FR is tagging an "abstract" item described in a diagram such as P&ID, hence there is neither outline nor interface definition. In addition, not all items constituting PBS-L3 are tagged with FRs, as mentioned before.

For example, there is no FR tagging interface components used to connect the pump and the pipe⁶.

In Figure A7, five situations are presented individually.

⁶ Sometimes, the interface components are delivered together with the main equipment, i.e. the pump, as a “kit” tagged with PNI. In that case, all those to be allocated to FR. In any case, it depends on the packaging/kitting strategy. See B2.4 and B2.5.

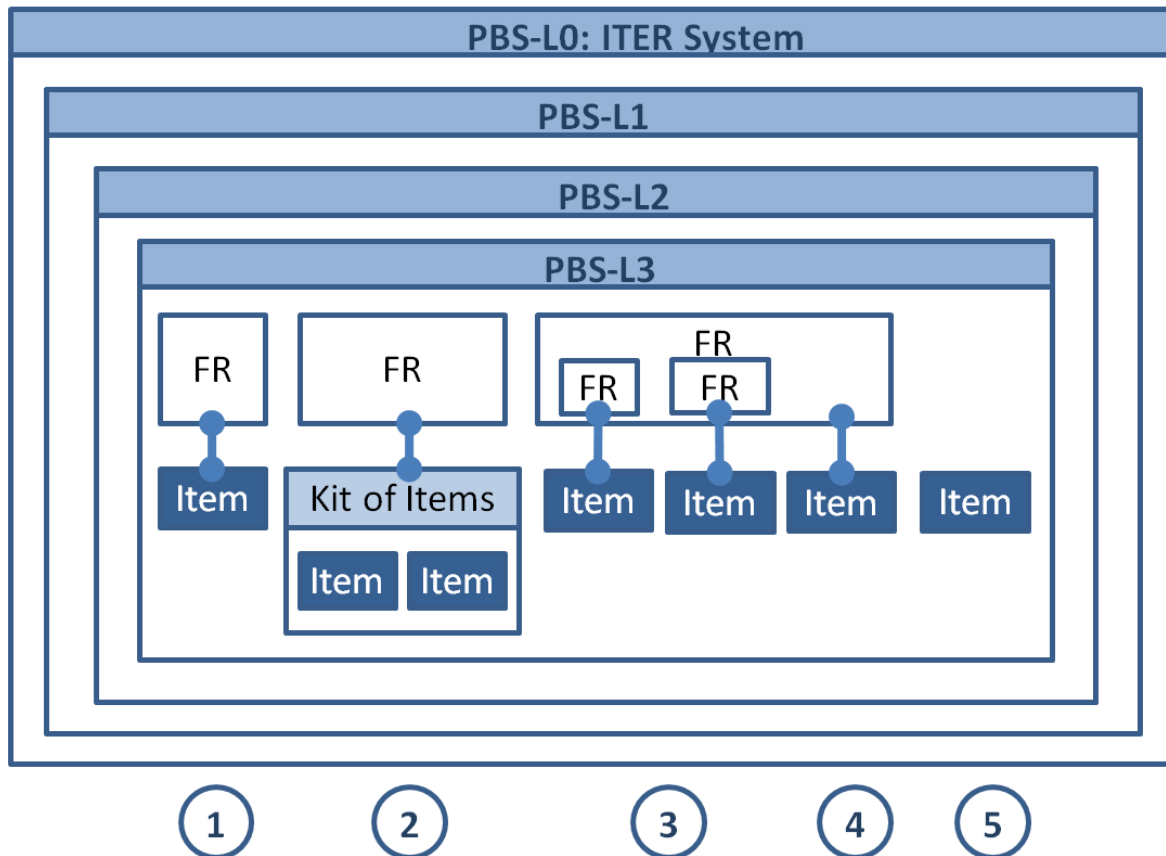


Figure A7 Allocation of delivered items to FRs within the ITER System.

- 1) One delivered item installed and tagged with FR;
- 2) One kit of multiple items assembled and tagged with FR. This can happen, for instance, for an equipment plus some interface components in a kit;
- 3) and 4) show a Complex System Component, e.g. pre-fabricated valve box. One FR enclosing some other children FRs. Allocation of delivered items to FRs are sometimes one to one, but not always (See Case-4) ;
- 5) Item delivered but not installed as a System Component tagged with FR. Finally the items without FR is just a component of certain PBS-L3.

Appendix-B Instruction for PNI

Additional explanations for PNI are given in this appendix.

B1 Examples and Use Cases of PNIs

There are two IT systems, i.e. CATIA/Enovia and SPMAT to generate PNI's, depending on the nature of Type Reference of the item:

PNI generated and catalogued by CATIA/Enovia (and CADENAS)

- Format of PNI tagging Type Reference of a mechanically designed item is shown below;
- CAD-Uid consists of 6 alphanumeric characters following the prefix, "I00."

I	0	0	A	A	A	A	A	A
Prefix "I"	"00" (numeric)		CAD-Uid 6 alphanumeric characters					

PNI generated and catalogued by Smart Plant

- Format of PNI tagging Type Reference of item in SPMAT is shown below;
- Regarding piping components designed with PDMS (AVEVA), this format of PNI is mostly used.

I	N	N	N	N	N	N	N	N
Prefix "I"	8 numeric characters							

Generation of PNI and the delivery to users are the responsibility of ESD/DO therefore users don't need to be concerned about the various in formats. They just need to request the necessary PNIs via CAD-ticket system and use them [UYGU3S (TBD)] once obtained.

B2 FAQ for PNI

B2.1 ITER Catalogue

- Type References of items i.e. Individually Distinguishable Items (IDIs) tagged with PNIs are registered in the ITER Centralized Material Database as "ITER Catalogue [UYGU3S (TBD)]";
- By referring to the PNI, all the item design related data can be extracted from the ITER Catalogue;
- Finally, PNI is the Primary Key code within ITER Centralized Material Database;
- PNIs of standard parts are controlled with SPMAT or CADENAS.

B2.2 CAD-Ticket to Request New PNI's

- PNI is generated and controlled by IO-CT in a centralized manner [UYGU3S (TBD)];
- Users request necessary PNI's via. CAD Ticket System whether the PNI generator is SPMAT or CATIA;

- Consumables of general usage such as paint shall be tagged with PNI too because they are also to be issued from the warehouse.

B2.3 Manufacturer Part Number, MN

- Manufacturer or supplier shall tag all manufactured or procured items with MN⁷ respecting the Quality Plan, in order to ensure the traceability;
- If an IDI is custom designed and shop-assembled, the constituting parts also shall be tagged with MN, exhaustively;
- In contrast, Commercial Off The Shelf (COTS) items do not require any tagging of their constituting parts;
- One PNI for a COTS may be associated with one or several compatible Manufacturer Part Numbers (MNs);
- MNs will be recorded together with the related PNIs in the ITER Centralized Material Database;
- See Appendix-D9, also.

B2.4 Shipment of Items

- In case of unique item in the ITER system, the IDI can be tagged with FR before the shipping, in addition to the PNI;
- All physical items shall be labelled / tagged as defined in [VYJ7U2] prior to shipping where the label shall comprise the PNI;
- IO-CT and DA shall communicate the Planned Delivery List before MRR because the as-delivered configuration can be different from the one expected by IO-CT as listed in the Expected Delivery List. New PNIs shall be provided to DA/Manufacturer by IO-CT, as necessary;
- It is recommended to group as a kit (“Kitting”) IDIs necessary for some construction Work Packages. When kitting, the item breakdown structure must take into account the construction process.

B2.5 Kitting

- Figure B1 shows an example of kitting. Taking into account the assembly process steps in the ITER site, delivered items are to be grouped as “Kits”;
- Each kit is to be tagged with PNI and the enclosed items can be tagged with PNIs also;
- Each kit is associated with Component (or Assembly) Drawings;
- The packaging for shipment shall be systematically grouped accordingly.

⁷ If PNI is used, MN is not always necessary.

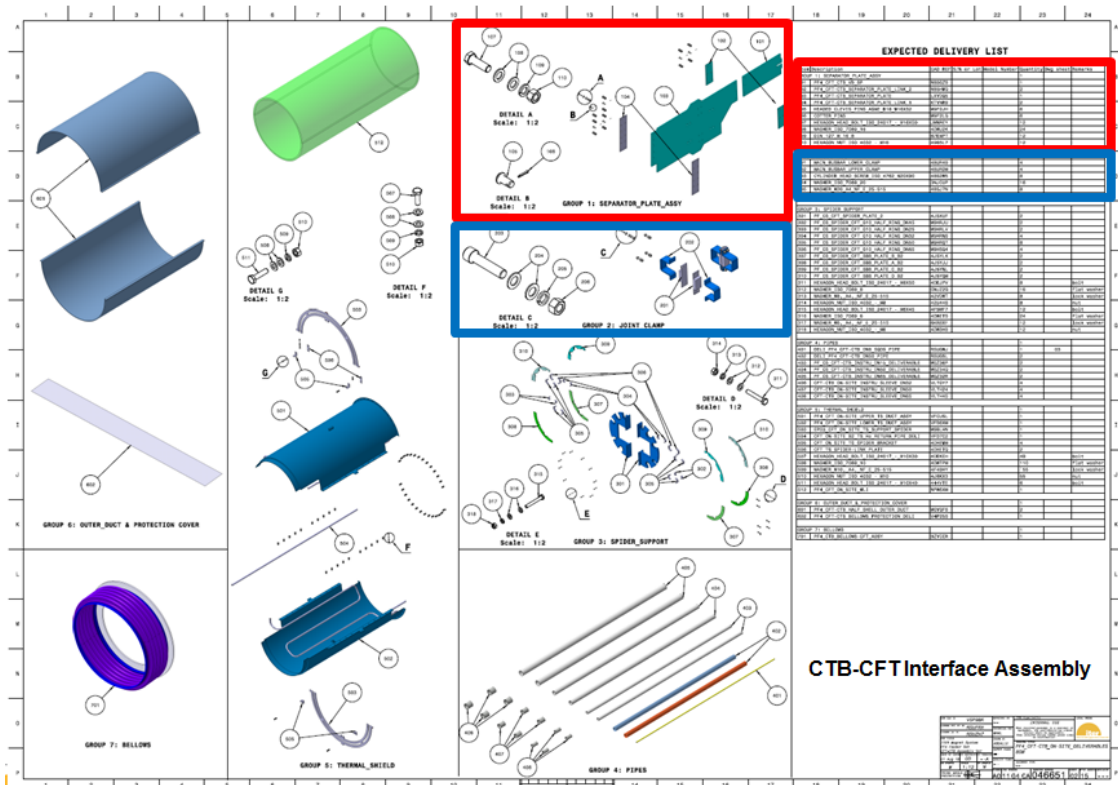


Figure B1 Example of Kitting for Magnet Feeder CTB-CFT Interface Assembly

B2.6 Parent and Child PNI's

All delivered IDIs shall be tagged with PNIs. However, frequently asked questions are related to the granularity or possibility of grouping. Figure B2 shows potential cases of delivered items tagged with PNIs.

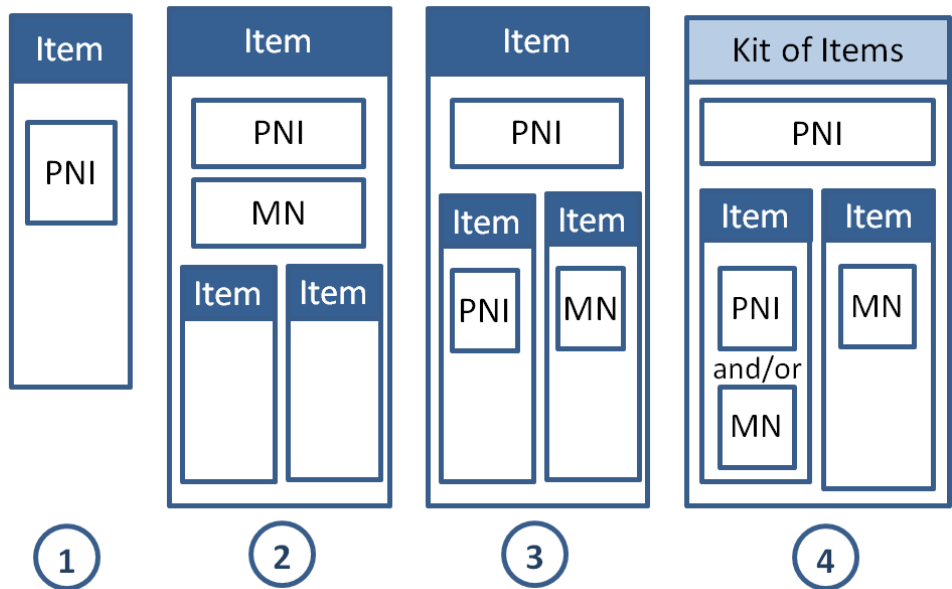


Figure B2 PNI's tagging of delivered items

- 1) Single item tagged with PNI. For instance, a motor;
- 2) A commercially available item (COTS) tagged with PNI, which consists of several parts, but identification of those constituting parts is not required. MN is also tagged as in the commercial catalogue.

Note: if the item is conforming to the specification, it is not necessary to tag each constituting part;

- 3) A custom designed and shop-assembled item consisting of shop-manufactured or procured items. The resultant item shall be tagged with PNI. Any part composing the resultant item shall be tagged with MN, at least. PNI can be used instead of MN;
- 4) A kit of items, which are shop-manufactured, is tagged with a PNI. The contents of items shall be all tagged with MN, at least. PNI can be used instead of, or in addition to the MN.

B2.7 Standard Parts and Bulk Item

Standard Parts :

- ITER Standard Type References are defined as any common type reference used more than 20 times and within various PBS Level-2's;
- An ITER Standard Type Reference can be either Commercial Off-The-Shelf (COTS) parts or an ITER specific standard, e.g. remote handling bolts.

Bulk Items

- Common parts can be managed as bulk items in the warehouse (e.g. stock of M16 Bolt (S304)) with dedicated PNI;
- Those items can be issued from the warehouse for replacement of a damaged part (in the “Kit”) as a spare part;
- Bulk items are mostly “Standard Parts.”

B2.8 Spares

- All Spare Parts shall be also tagged with PNIs;
- Spare parts with the same PNIs as the one of the installed item can be used for replacement;
- At shipment, spare parts shall be separated from the ones to be used for the construction. Those to be used for the construction are kitted and packaged systematically taking into account the construction process steps (so they are not treated as “bulk”).

B2.9 Version Control (TBD)

- The design of an item is changed when a PCR or a DR is approved and implemented;
- The Item revision number shall be controlled with the revision number(s) of the relevant design documents, e.g. Tech Spec, drawings and/or the Engineering Dossier, which define the design solution;
- PNI is not a “self-talking” or random number without Rev. Num. included. Therefore for revision control of the item, relying on IT database, additional information shall be always displayed with PNI;
- For example, in the ITER Centralized Material Database, in order to control design changes, a certain version of the design solution can be found as:

PNI	-	Tech Spec	Rev#	-	Drawing	Rev#
-----	---	-----------	------	---	---------	------

- Similarly in the case of non-conformance, a Non Conformity Report, NCR, is issued, then approved or rejected by IO-CT. In case of approval, that NCR shall be associated with SN.

Appendix-C Tagging in Construction Site and Warehouse

- In Figure C1, correlation between PBS-L3 node, FRs (equivalent to PBS-L4) and delivered items is illustrated in the construction site or in the warehouse;
- Items are delivered and then assembled or installed in a certain location of the ITER system. This story can be mentioned “As-delivered item is allocated to FR”;
- In this diagram, all items or kits are tagged with both PNIs (or MNs) and SNs. Therefore, all 3BM identifiers are linked together at the moment of site-assembly / installation.
- FRs are abstract and not exhaustive so situation of 4) can occur. This is when the IDI is assembled just as a part of the PBS-L3 but not related to any FR tagging..

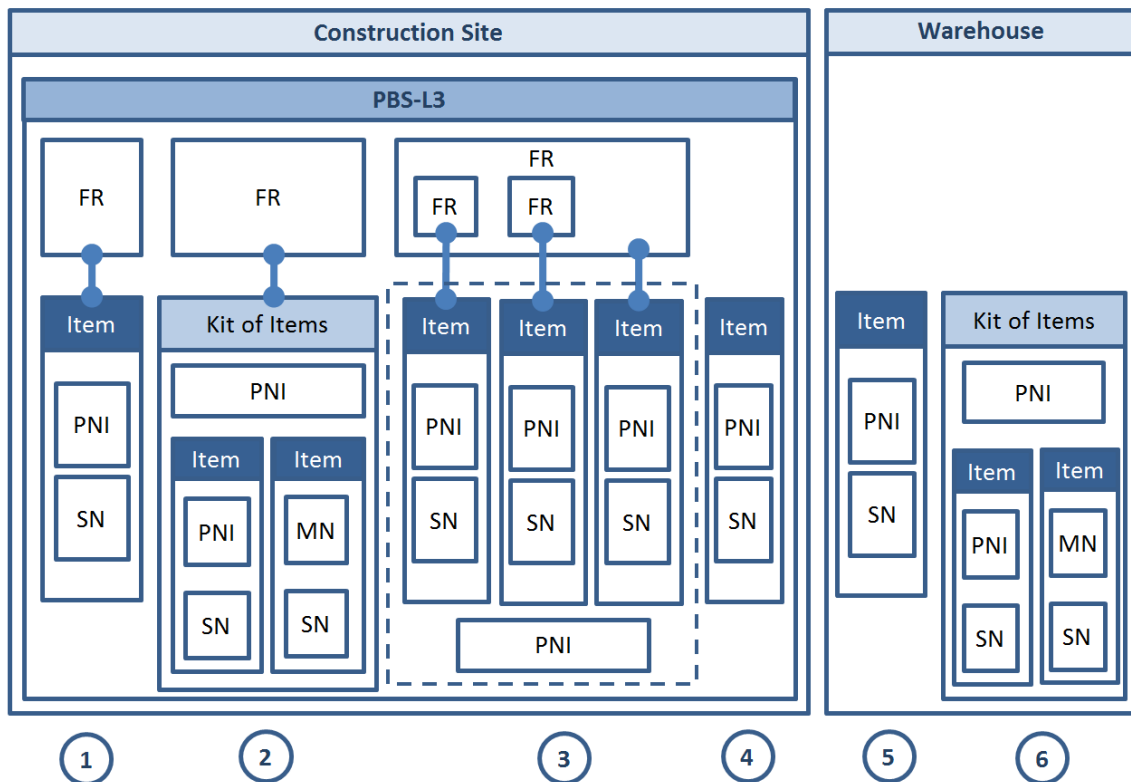


Figure C1 Correlation between PBS-L3 node, FRs and delivered items in the construction site or in the warehouse.

1. The simplest case, an item, e.g. COTS, delivered and installed;
2. Multiple items packaged as a “Kit” which is tagged with PNI. All the items are to be assembled as a System Component tagged with FR;
3. Some items are allocated to individual FRs, those are enclosed in the parent FR. One item (on the most right) is assembled as a part of the parent FR. An example is a valve box. Individually enclosed valves and other parts, e.g. shims between the valve box and the Embedded Plates, are tagged with FRs and no identifier, respectively.
The dotted line shows the Complex Component designated with the PNI in the design;
4. Assembled, but no tagging with FR;
5. One component as-stored in the warehouse (not yet on the construction site)
6. A kit stored in the warehouse as delivered.

Case 4) to be detailed in an other document from data management view point. Completion of the construction is confirmed with fulfilment of the related IFC-BOM and Assembly Drawing.

Appendix-D Supplementary ID-Code Schema

D1 Part Index

Within the detailed Diagrams or 3D models, there is a part as a specific member of a given System Component which should be identified.

The Part Index will be used for referencing:

- Items which may need to be located uniquely during mounting, inspection or for a maintenance procedure within a System Component.
- Custom fitted physical items, assembled at IO premises, within a System Component.
- Within very specific cases, a part which may require being identified for its specific function below the System Component itself as low voltage module within a cubicle.

In most cases, the Part Index should only need to be applied on drawings.

The Part Index syntax is:

$$A[A][N]NN$$

- An uppercase ASCII alphabetic code of 1 or 2 characters use to designate a type of part;
- An integer of 2 or 3 ASCII digits. 0 may be used in front to obtain proper alphabetic order in listing.

The total length of the Part Index shall not exceed 5 characters. A given order shall be established in the sequential number following position or assembly logic. The Part Index shall be unique within a given System Component.

Format and Example

If required, an absolute address of the part Index including the concerned System Component can be used and shall be of the following syntax:

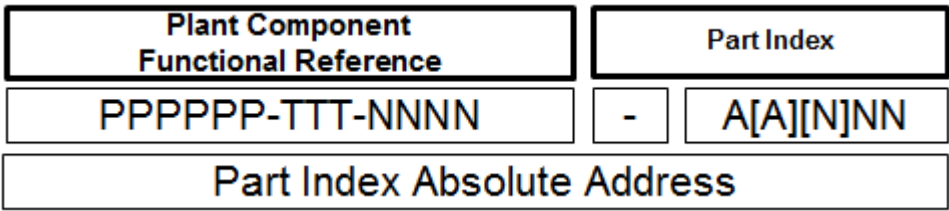


Figure D1 Absolute address of a Part Index

Note: Due to constraint over software, the “-” separator may be replace by “/” or “:” within these software but not on any physical marking.

D2 ISA Reference

The ISA Reference is an additional identifier which shall be used for all classes of process measurement and control instrumentation.

It is applicable to instrumentation falling under one of the following conditions:

- Instrumentation accessible during operation or maintenance.
- Instrumentation involved in Process Control or monitoring (for example a Pressure Transmitter, while the counter example would be a personal Dosimeter Reader)

- Instrumentation measuring or controlling variables of a given System Component (ex : Pressure associated to a tank)

Instrumentation function integrated within a System Component (example: on/off switches on a valve) may also be referenced using an ISA Reference and does not require a FR.

The ISA Reference of an Instrument uses the FR of the measured System Component. This enables the operator to first locate the measured System Component (generally of important dimensions) and then the related instrument, which is important for ergonomic and fast intervention.

The ISA Reference is built by application of “*ISA 5.1-2009: Instrumentation Symbols and Identification*” following the notion previously described of the PBS Identifier and Function Category.

Format and Example

The syntax of the ISA Reference and related loop is built as below :

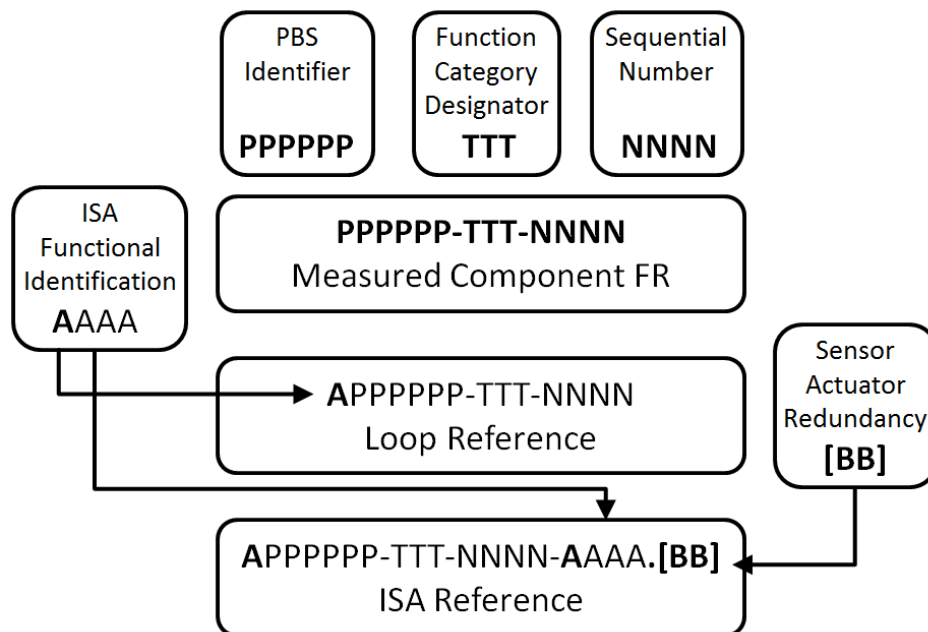


Figure D2 ISA Reference grammatical Schema

Table D1 ISA Instrument Reference Coding Table

Label	ISA Name	Description	Optional	Format
PPPPPP	System Prefix	PBS Level 3 of the Measured System Component and loop	N	6 alphanumeric uppercase ASCII characters
A	ISA Loop Variable	Measured or initialing Variable of the loop as per ISA 5.1-2009	N	1 uppercase ASCII Letter Measured or Initiating Variable
AAAA	ISA Functional Identification	functional identification of an instrument as per ISA 5.1-2009 (see AAAA Codes)	N	2 to 4 uppercase ASCII Letters including signal Level coding (H,L)
TTT	Loop Number Prefix	Main Controlled Component Function Category	N	2 or 3 ASCII uppercase letters or under specific condition 2 uppercase ASCII field and a ASCII digit
NNNN	Loop Number Counter	Main Controlled Component NNNN	N	4 alphanumeric uppercase ASCII characters
BB	Sensor Redundancy	Used for multipoint measure or a redundant sensor	Y	1-2 numeric for multipoint 1-2 ASCII uppercase letter(s) for redundant

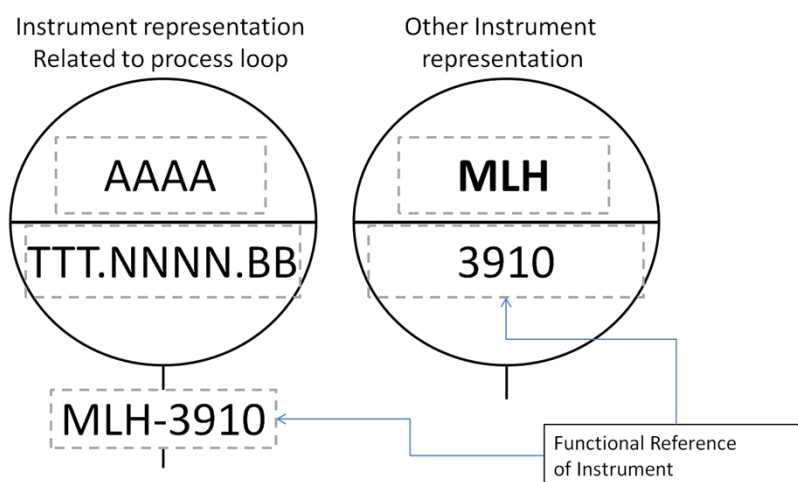


Figure D3 Instrumentation Representations

The representation of a process or function instrument in relation with a process loop is represented on left side of Figure D3. Concerning other instruments, either isolated or not directly involved in process control (earthquake measurement, analyser, etc.) this representation is shown on right side of Figure D3 shall be used.

The FR of the instrument, shown here as *PPPPPP-MLH-3910*, is required to be displayed below the symbol. An example of its application is given in Appendix-E.

The ISA Reference has common field with Signal Identification defined in [Signal and plant system I&C Variable Naming Convention \(2UT8SH\)](#).

D3 Trial Fit at Supplier's Premises

During trial fits of a specific component taking place at the manufacturer's premises, some part may be adjusted (or included electronics can be calibrated) in order to ensure preliminary qualification.

For logistical constraints, this component may be disassembled for shipping and re-assembled for installation at IO. If several components of the same type reference have been produced in the same above condition, it is needed to acknowledge which part of each trial fit goes together. Therefore, a trial fit marking will be used to differentiate them back on site.

The identification of items involved in a given trial fit will be done following the Keyword FIT- followed by an ASCII character as an identifier of the trial as shown in Figure D4.



Figure D4 Trial fit marking

A Trial Fit Marking shall be placed on each part of the component delivered, directly on the part and also on packaging. The Trial Fit Marking shall be removable.

D4 Pre-Assignment Field

The Pre-assignment Field is a partially filled-in FR or Part Index using the ASCII underscore “_” as a wildcard (example: 11F1GS-ZJ-0_00, 11__GS-ZJ-0_00).

The wildcard can replace:

- One or several characters of the PBS (PPPPPP)
- One or several characters of the Differentiating Number (NNNN)
- One or several characters of the Part Index (A[A][N]NN)

The Pre-assignment Field shall not supersede any of the 3BM identifiers.

The Pre-Assignment Field enables identification of a group of items which are strictly identical in their design (meaning that they share the same 3D design, CAD UID reference, technical definition and have an identical Type Reference within Bill of Material.)

The Pre-assignment Field shall be visible at delivery on the component if used.

The following restriction of usage shall apply to the Pre-assignment Field:

1. The field will not over constraint the possible final location, i.e. shall not represent specific FR in order not to limit flexibility of placement during construction.
2. The field will only be used for items with limited number of occurrences (<100).
3. The field will not be used for any out-of-the box components like valves, bolts or for items used by several PBS or massively instantiated.

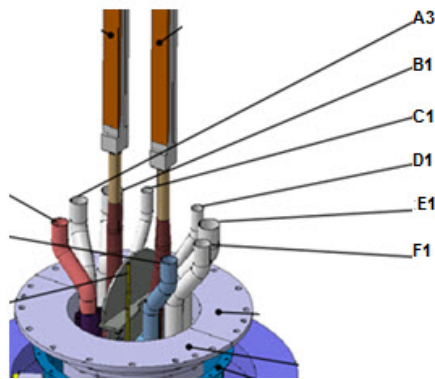
Application of Pre-Assignment Fields is given within Appendix-F

D5 Interface Locator

To ease assembly operations between components, an Interface marking or sticking on components shall be used.

The Interface locator shall be visible on the component areas that are to be assembled together, in order to identify a piece, area or edge that should be matched at assembly. The same short identifiers (example AC10, DC66...) are marked on each mechanical piece location that is supposed to be joined.

The following example shows how these locators should be specified in drawings and in the related table:



Locator	Component A	Component B	Description
A3	11G4CF-CT-1310	11G4CF-CT-2310	DN60 Schedule 10 BE
			Weld Spec : UDM4TR
B1	11G4CF-CT-1320	11G4CF-CT-0310	DN40 Schedule 10 BE
			Weld Spec : UDM4TR
H1	11G4CF-CT-1310		Lifting Ring (4 locations)

Figure D5 Example of Interface Locators and related specification

It is also to be noticed that several locations may get the same tag as for lifting ring.

General rules for the Interface Locator Identifier are as follows:

- The identifier will be the concatenation of an upper-case ASCII alphabetic string and an integer, both optional;
- The total length of the identifier will not exceed 6 digits;
- String shall refer to a connection type and/or a grid 1st address;
- An Integer shall follow a comprehensive spatial logic to ease mounting.

D6 Piping Related Referencing

D6.1 Pipe Spool Address

The Piping line⁸ is the breakdown for fabrication and installation into the segment call spool which can be manufactured in the shop-floor or on-field, following assembly feasibility check. All spools are welded together on-field to finalize piping line construction. The spool identifier is built as such:

Piping Line Functional Reference	Spool Number
PPPPPP-PI-NNNN	- SPLNNN
Spool address	

Figure D6 Piping Spool Address

⁸ Pipe spool may also be recognized as “Process-Non-Functional System Component” tagged with FR. However, it also contains several pipes belonging to pipe lines tagged with different FR’s. Where those pipelines are recognized as “Process-Functional System Components” appear in the diagrams and in the Control Monitor Screen, in future. Note that many isometric drawings for pipe spools are already tagged by Process-Non-Functional FR codes, as the drawing numbers.

With: PPPPPP-PI-NNNN signifying the piping line FR

SPL signifying the abbreviation for Spool

NNN signifying a 3 digit integer: starting by 1 at one of the extremities of the pipe.

Each Pipe spool gets assigned a PNI.

D6.2 Piping Line Piece Index

Piping line Piece Indexes are unique for a given piping line and not to the whole plant.

The Piping line Piece Index is used on spool isometric drawings for fabrication and welding maps. It is generally automatically assigned during isometric generation and is built as such:

AAAANNN

With:

- The first four characters (AAAA) corresponding to an existing list of piece type codes used. It is using four ASCII uppercase characters.
- NNN being a 3 digit integer starting by 1 at one of the extremities of the piping line.

It is to be taken into account that:

- Piping line welds and gaskets will be identified on non-PIC piping line for inspection and qualification.
- Piping line pieces, welds and gaskets will be identified on PIC piping line for inspection and qualification.

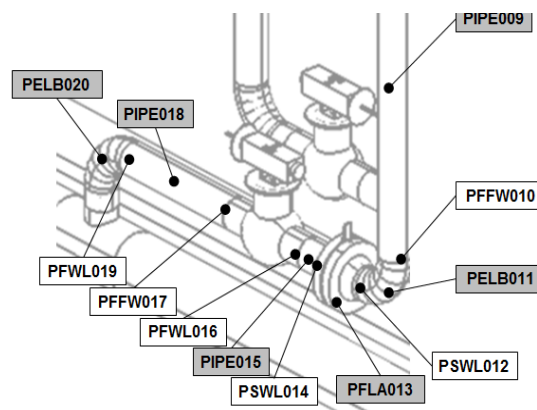


Figure D7 Piping Line Piece Index on a PIC line

The following keys will be used for naming the piping piece:

Table D2 Example of piping pieces

Key	Usage
PBRA	All Branches including the BOSS, CROSS, OLETS, LATERAL, TEE, WYE and THERMOWELL
PELB	All ELBOW and REDUCING ELBOW
PIPE	All STRAIGHT PIPE and PIPE WITH BEND
PFIT	All Fittings including the ADAPTER, CAP, PLUG, CONNECTOR, NIPPLE, REDUCER, STUB_END, SLEEVE, COUPLING, UNION, BUSHING, REDUCING INSERT, NUT, CLAMP, CLAW
PFLA	All FLANGES
PGAS	All GASKETS
PFWL	All FIELD WELD
PSWL	All SHOP WELD
PWLD	WELD (category unknown)

The following keys will be used for naming HVAC piece :

Table D3 Example of HVAC pieces

Key	Usage
HBRA	All Branches including the CROSS, LATERAL, TEE, WYE and TAP
HELB	All ELBOW
HOFT	All OFFSET
HTRA	All TRANSITION
HDUC	All ROUND DUCT AND RECTANGULAR DUCT
HFIT	All Fittings including the COUPLING, COLLAR, END CAP
HFLA	All FLANGES
HGAS	All GASKETS
HACC	All ACCESS COVER

D6.3 Nozzle Naming

Nozzle naming on a fluid System Component shall be used on diagrams, drawings and via permanent labels on physical components to secure mounting, maintenance and fulfil human engineering. Hereunder is the nozzle naming convention to be followed using one ASCII uppercase character and optionally an integer:

Table D4 Example of Nozzle Naming

Process Nozzle	Instrumentation Nozzle
FX for Inlet/Fill	LX for Level Measurement
EX for Outlet/Exit	PX for Pressure and Vacuum Measure
VX for Vent or Relief	TX for Temperature Measure
DX for Discharge and Drain	RX for Radiation Measure
PX for Rotating device (agitator/pivot)	AX for Analytical Measure
	KX for Leak Detection
MX for Maintenance and Man Hole	SX for Sight Glass

The Integer X following is optional and shall only be used if several nozzles of the same type exists.

Table D5 Example of Pping Nozzle Table for a Tank

Noozle	Noozle Description	Connected to	Description
T	Temp. Measure	76BDCF-MTS-1012	DN25 Pressure Rating 40
			EN1092-/11
I1	Nitrogen In	76BDCF-PI-1012	DN80 Pressure Rating 40
			EN1092-/11
I2	Water In	76BDCF-PI-1022	DN50 Pressure Rating 40
			EN1092-/11

D7 Referencing Electrical Enclosure

Electrical enclosure will be a System Component using (in most cases) the following TTT-codes:

CR	Cabinet, box
BJ	Box, junction or terminal
CU	Cubicle
BS	Board, switch or switchboard
CMC	Motor Control Cubicle
BP	distribution panel, Board
CUT	Cubicle, termination hardware
CX	box for radiological data treatment
BN	Board, terminal
BR	Board, relay
BD	Board, distribution

Cubicles containing any equipment playing a primary role in Instrumentation & Control System, such as PLCs, Remote I/Os, Plant System Hosts (PSHs), and Network Switches are considered as System Component. Therefore, the Cubicle acts as an enclosure for these System Components.

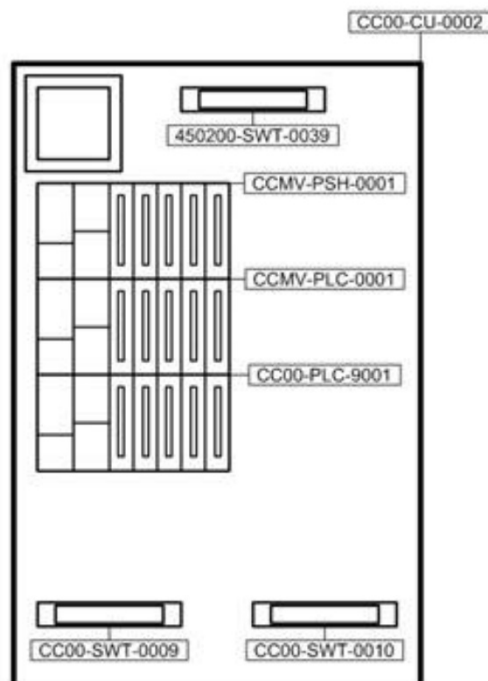


Figure D8 An electrical enclosure

Low voltage Electrical and Electronics Parts and Equipment within Electrical Enclosure such as the Low Voltage breaker, Contactor or Disconnecter shall follow the following label format:

A[AA]NN

- The first one or up to three uppercase ASCII characters (AAA) shall follow designation given in [Reference Designation Letter for Low voltage part Identification \(WEZTST\)](#) following “IEC 81346-2:2009: Industrial systems, installations and equipment and

industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes.”

- The last two (NN) are Differentiating Numbers.

Within detailed electrical cubicle diagrams, the FR of the cubicle will be displayed on the title block and optionally together with the Part Index of the low voltage modules (See D1).

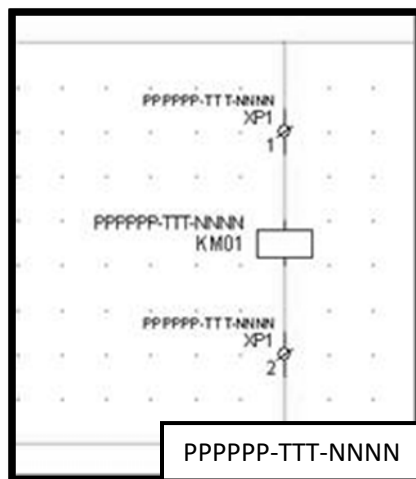


Figure D9 Label for FR and Part Index on Detailed Electrical Diagrams

D8 Referencing Wall Openings and Penetration

The Part Index shall be used to identify sub-assemblies having specific penetration and interface functions within opening. The Prefix SL for Sleeve is used and is followed by two integers.

The increment shall start from upper left to lower right by column.

Format and Example

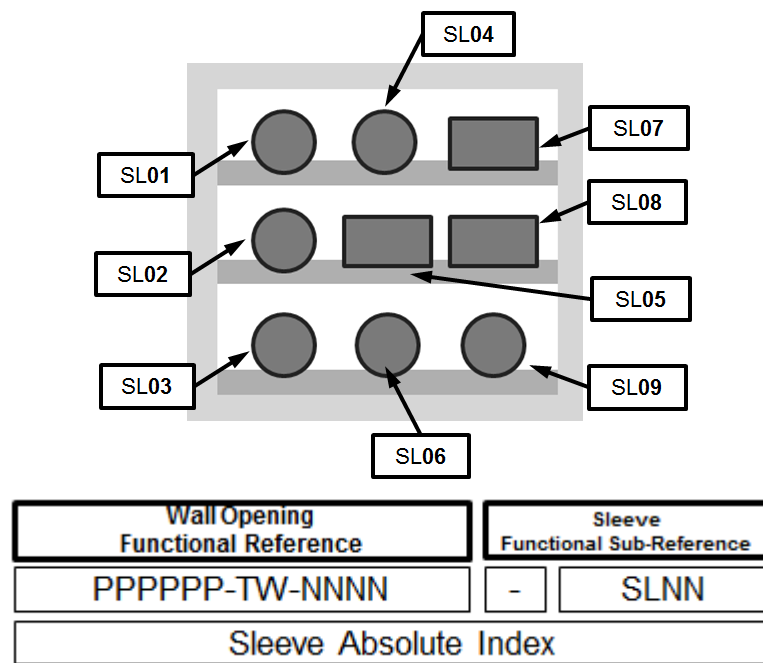


Figure D10 A Wall opening with multiple crossing sleeves

D9 Manufacture Part Number, MN

- MN is required for any item managed by manufacturer regardless of items to be delivered or of those constituting such items;
- Numbering scheme for MN is at the discretion of DA/Manufacturer;
- Any documentation, e.g. design document in manufacturing dossier, quality control records, shall be traceable with MNs;
- If PNI is affixed, MN is not always required. Both PNI and MN tagging the same item are allowed;
- MN includes Supplier Vendor Number; Universal Product Code, coded description according to an applicable industrial code, etc.

D10 Commodity Code

Commodity code is a default feature in Smart Plant Materials (SPMat), representing item family

Format and Example

For standard parts, a part family provides all possible dimensions of a given standard (ex: Screws - Countersunk Head, Hex, DIN 7991 SS316L from M1.6 x 4mm to M12 x 120mm), as shown in Table D6. This part family is reference by a Commodity Code, which is an alphanumeric ASCII code, and a Commodity Description.

Table D6 Commodity Code and PNI of Piping parts

PNI	Commodity Code	Commodity Description	DN	Schedule
-----	----------------	-----------------------	----	----------

I0155208	PPPABRBEATWAAG	15 x S-10S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-10S
I0155211		15 x S-40S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-40S
I0155213		15 x S-5S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-5S
I0155214		15 x S-80S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-80S
I0155219		20 x S-10S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-10S
I0155222		20 x S-40S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-40S
I0155224		20 x S-5S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-5S

Commodity Code is generated respecting the Commodity Description as shown in Table D7.

Table D7 Elementary codes composing a Commodity Code and the description

	Group	Part	Dim System	Dim Standard	End Prep	Material System	Material	Alias
Commodity Code	P	PP	A	BR	BE	A	TW	AAG
Commodity Description	Pipe		ASME-B36.19		BE	ASTM A376-TP316		SMLS

In Smart Plant, PNI⁹ is calculated from the Commodity Code, as follows:

$$\text{“PNI”} = \text{“Commodity Code”} + \text{“Physical Dimensions (e.g. DN, Schedule)”}$$

Regarding a specific custom-made mechanical item, Commodity Code can be a TTT-code, which represent a functional category of component.

D11 Lot / Batch Number and Heat Number

Discretion of DA and Manufacturer.

⁹ In Smart Plant, PNI is called as “Ident code.”

Appendix E Tagging Example for Instrumentation

The example in Figure E1 shows a tank, 26CVDV-TA-0040, with multiple level switches and a redundant measurement instrument for the maximum fill level. These level switches are all related to the control level loop of the tank. Their ISA References are all of the form **L26CVDL-TA-1540-LSXX.Y**, thereby clearly referencing the System Component being measured.

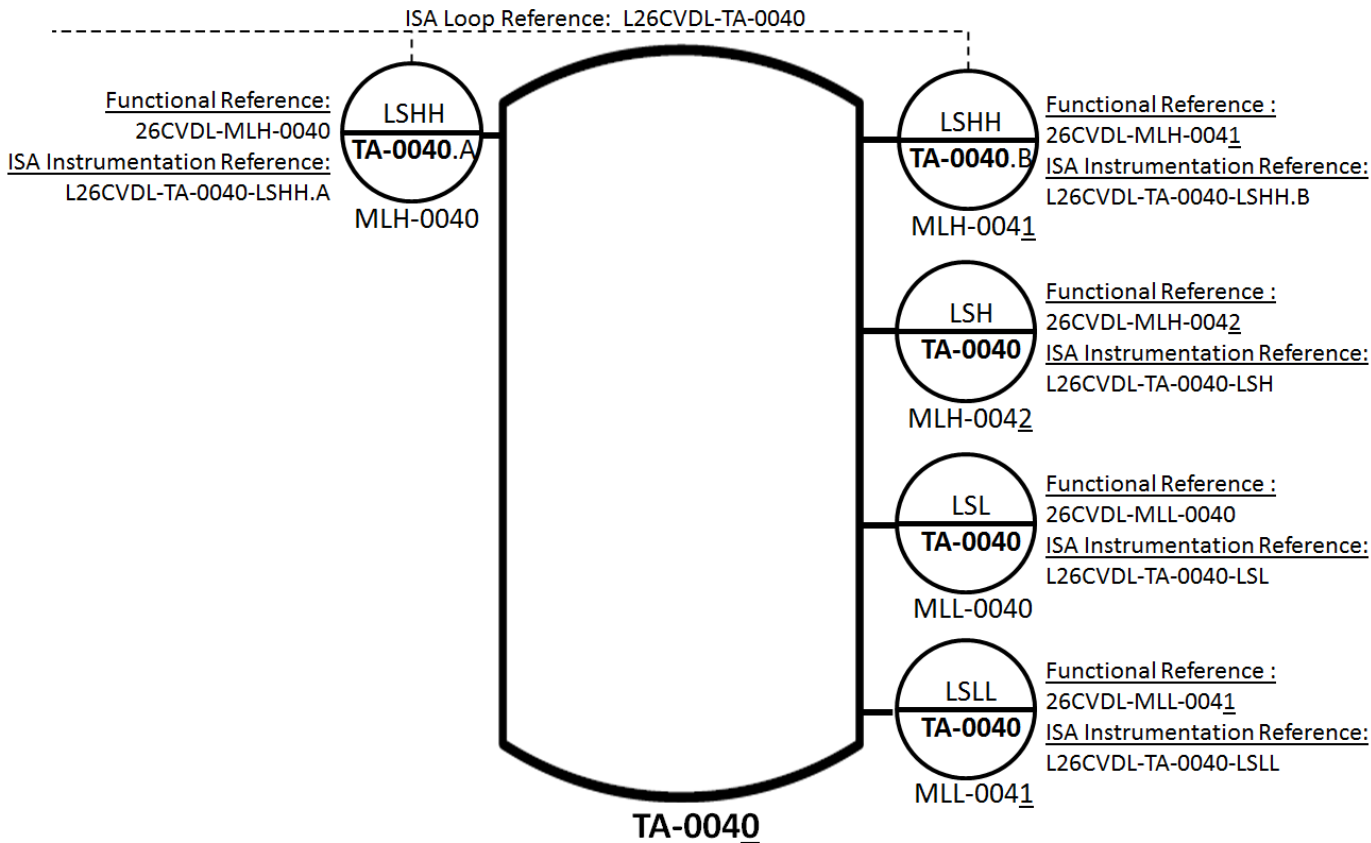
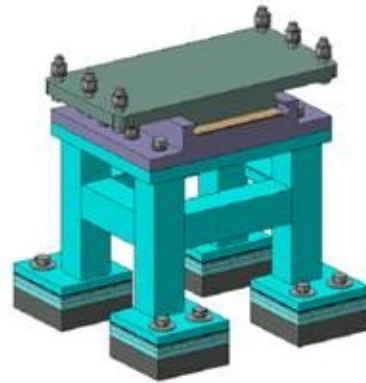


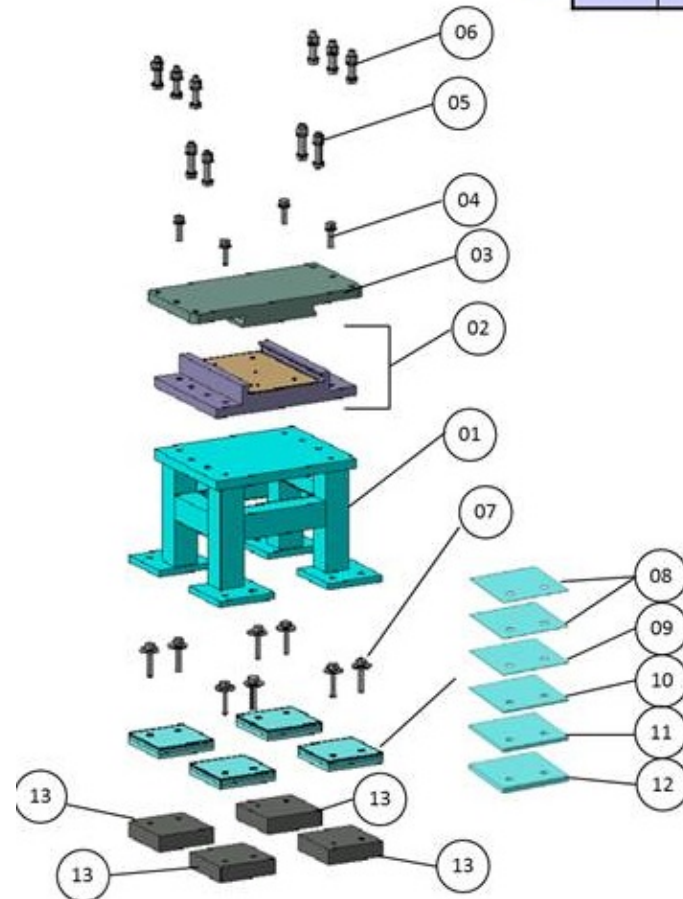
Figure E1 Example of ISA codes with FR's

Appendix F Tagging Examples for Mechanical Cases

Sample Identification using Pre-Assignment and Part Tag Field



Item	DESCR	CADREF		Pre-assignment	PNI	Commodity Code	QTY	Material	Identifier marking	
		Enovia	Ver.						IO identifier	Type
○	CFT_GRAVITY_SUPPORT_STR3_3RD	4F7BE2	--E	11_CF - ZJ - 0300	I004F7BE2	BCAPABNBEAS5ABAZ	1		11_CF-ZJ-0300 PNI: I004F7BE2 SN:	engrave
●	01 GRAVITY_SUPPORT_FRAME_STR3_3RD	42D4B	--F				1	304L		
●	02 DOVE_TAIL_ASSY	42D4E	--G				1			
●	03 G_SUPPORT_SLIDING_CONNECTION_UPR	4F593X	--C				1	304L		
●	04 BOLT_NUTS_M20X65	6TKYXS	--A				4			
●	HEXAGON_HEAD_BOLT_ISO_24017_-M20X65	6VQ75K	---		I98412548	BE4LABNBEAS5ABAZ	1	316LN		
●	WASHER_W20_A4_NF_E_25-515	UOK45Y	---		I98412579	OEBLAP2SSWAWZZZ	1	316LN		
●	WASHER_ISO_7091_20	4F45MK	---		I98412894	GSWAB9DRFAZHA1MZ	1	316LN		
...	...									
●	08 SUPPORT_SHIM_1MM_L	4F4NKF	--E				8	Q235B		
●	09 SUPPORT_SHIM_2MM_L	4F4NPH	--E				4	Q235B		
...	...									
●	13 CARBON_STEEL_BASE_PLATE	6FR38D	--D	11_CF - ZJ - 0300 /00_	I004F7BE8	GSWAB9DRFAZHA1MZ	4	Q235B	11_CF-ZJ-0300 /00_ PNI: I004F7BE8 LOT #:	engrave



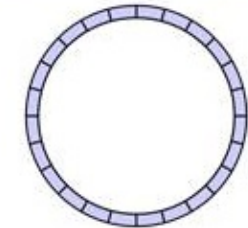
Introduction:

20 identical Gravity supports are used within a circular pattern.

A single BOM is used to describe them using Pre-assignment.

The supports are to be delivered assembled except for the Carbon Steel Base Plate (13) which will be custom fitted according to civil engineering.

BOM as designed (shown), BOM as build and BOM as installed will be unique for each Gravity support with SN and FR mark-up.



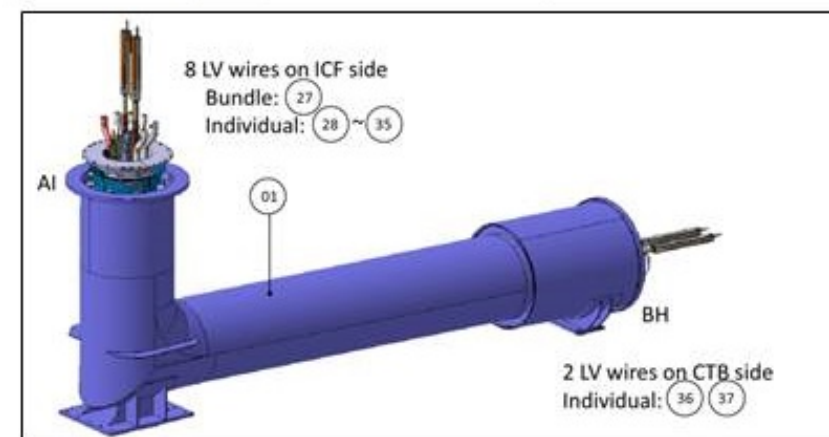
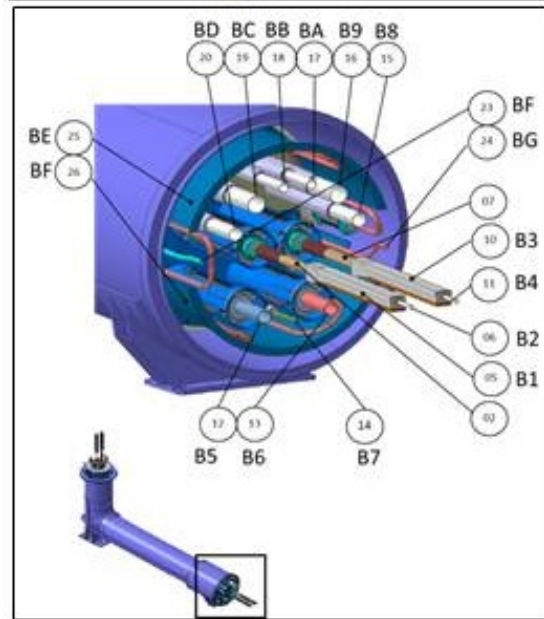
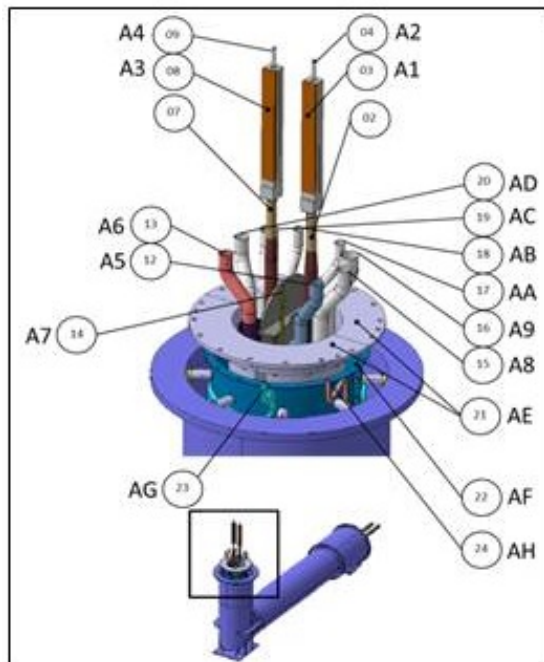
Line by line explanation:

- Top node representing one of the 20 supports with 20 possible FR values and a PNI to identify at delivery.
- Part or assembly of the gravity support; no PNI is required as the supports are delivered assembled.
- Standard Part coming from CADENAS Software. A PNI shall be provided automatically. It is not mandatory as it is delivered assembled in this case.
- Carbon steel plate is custom fitted, thus it requires a Part Tag to follow the exact final location, where once installed is no more interchangeable. As it is delivered separately, a PNI is needed.

Notes:

- Pre-assignment is optional, its marking shall not supersede PNI or FR one.
- Gravity support (top node) and Carbon Steel Base Plate (13) are Non-Standard type references – CAD UID used as PNI.

Sample Identification using Enclosure and Interface Marking



Item	Description	CADREF		Functional Reference	PNI	Commodity Code	QTY	Material	Identifier marking		Interface marking	
		Enovia	Ver.						IO identifier	Type	Interface ID.	Type
00	PF4_CFT_ASSY_B2	45Y396	--J	11G4CF - VDT - 0100	I0045Y396	MECH	1	304L (Mainly)	11G4CF-VDT-0100 PNI:I0045Y396 SN :	engrave	AI / BH	engrave
01	PF4_CFT_VACUUM_DUCT	EA5GUG	--E									
02	PF4_CFT_BB_ASSY_L	R4TBZ3	--B	11G4CF - JB - 0100								
07	PF4_CFT_BB_ASSY_R	R4TBYK	--B	11G4CF - JB - 0200								
08	MAIN_FEEDER_HALF_JOINT	TN964E	--B								A3	engrave
09	DN10_PIPE_ON_MB_JOINT_BOX_END	T7PD7F	--B								A4	sticker
12	PF4_CFT_DN50_He_SUPPLY_PIPE	RBLXRV	--B	11G4CF - PI - 2410							A5	sticker
13	PF4_CFT_DN50_He_RETURN_PIPE	RBLXQD	--B	11G4CF - PI - 2610							A6	sticker
14	PF4_CFT_SQDS_PIPE_ASSY	RBLXWG	--B	11G4CF - PI - 4492							A7	sticker
15	PF4_CFT_INSTRU_PIPE_B_R_ASSY	US2Q4Z	---	11G4CF - CDT - 0101							A8 / B8	sticker
16	PF4_CFT_INSTRU_PIPE_C_R_ASSY	US2Q2Y	---	11G4CF - CDT - 0102							A9 / B9	sticker
22	PF4_CFT_THERMAL_SHIELD	R4TB6W	--B								AF	engrave
23	PF4_CFT_TS_PIPE_INLET-2	R4TAUV	--B	11G4CF - PI - 2800							AG / BF	sticker
24	PF4_CFT_TS_PIPE_OUTLET-1	R4TAWS	--B	11G4CF - PI - 2801							AH / BG	sticker
25	CFT_B2_SBB_HALF_SIDE_TRANSIT_DUCT	HSUMGG	--B								BE	engrave
26	CFT_B2_SBB_HALF_SIDE_TRANSIT_DUCT	HSUMGG	--B								BF	engrave
27	CABLE_PF4_SENSOR_CFT_TO_PP_ICF	SM999B	--A									
28	CABLE_PF4_SENSOR_CFT_TO_PP_ICF	SM999B	--A	11G4CF - CAM - 3800	I14636685	BRECABNBEASS	20 m		11G4CF-CAM-3800 IDENT: I14636685 SN:	Laser		

Introduction:

A Cryostat Feed Through modified BOM for example.

The Feed Through is considered as an enclosure hosting crossing-through routed components with FR.

The Feed Trough is delivered assembled reducing PNI management.

This Feed Through design is unique.

Line by line explanation:

- Top node representing both the vacuum duct parts and the various components within the duct (Junction Box, Pipe and Electrical conduit). This design solution is unique, so the manufacturer can be requested to engrave the FR.
- Component within the Feed Through, normally declared on Diagrams; no PNI is required as delivered assembled.
- Mechanical Part of the Feed Through, no PNI is required as delivered assembled.
- Cable may be subject to replacement, therefore a PNI must be assigned.

PF4 feeder is the unique item in ITER system, therefore FR can be added to the BOM

Appendix-G Function Category Designator, TTT-Code

TTT-codes can be categorized into two types, i.e. 1) Process-Functional and 2) Non-Process-Functional as illustrated in Figure G1. TTT-codes are also classified per disciplines, e.g. Fluid, Instrumentation, Mechanical. MQP document [2FJMPY] describes more in detail.

Process Functional

- If a System Component is related to a process or a network, it shall be tagged directly on a diagram, with a Process Functional TTT code. For example, a Tank, a piping line, an Instrument, a cubicle, a cable;
- Those appears in a diagram, control monitor screen, etc.

Non-Process Functional

- If a System Component is not involved in a process, it shall be tagged only in the 3D model, with a Non-Process Functional TTT code;
- Pipe spool, special shims are in this category.

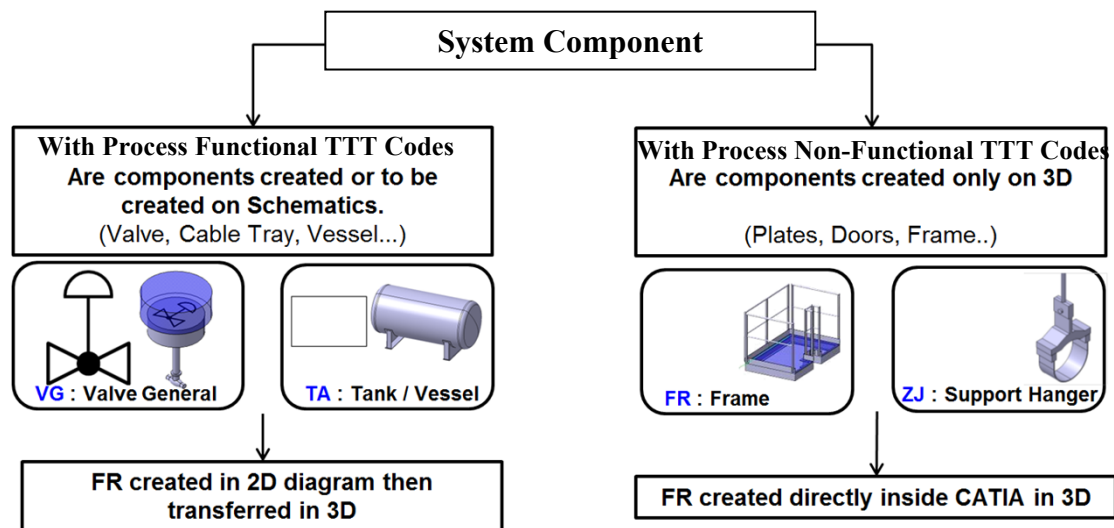


Figure G1 Function Category Designator, TTT codes

Request for New TTT

The criteria of TTT codes, which are exactly the same as for FR, are as follows:

- System components appear in diagram, operation console;
 - Any other component on which IO-CT has interest, e.g. Item to be maintained, replaced.
- Requests for new TTT-codes shall be performed via IO CAD Ticket System:
 - Queue: ITER NUMBERING SYSTEM,
 - Service: TTT code request.
 - Within a request, a description of the wished TTT-code (example: PC - Compressor) shall be provided;
 - The Request will have to follow MQP procedure [2FJMPY] and will be checked if it corresponds to a function which can be given to a component and does not overlap with the existing TTT codes.

Appendix-H Summary of Identifiers in [28QDBS]

3-Ball-Model ID-code				Supplementary ID-code and/or sub-ordinate code		
	Type of ID-code	Format	Description	Type of ID-code	Format	Description
Plant Component	FR (Functional Reference Number [Sec. 6.1])	PPPPPP - TTT - NNNN	ID-code on a System Component which locates in certain position within the ITER system having certain functionality	ISA Loop Reference [Sec. D2]	APPPPPP - TTT - NNNN	-
				ISA Reference [Sec. D2]	APPPPPP - TTT - NNNN - AAAA - [BB]	-
				Part Index [Sec. D1]	PPPPPP - TTT - NNNN - A[A][N]NN	For constituting parts
				Pipe spool address [Para. D6.1]	PPPPPP - PI - NNNN - S P LNNN	Spool to be in a line
				Piping Line Piece Index [Para. D6.2]	PPPPPP - PI - NNNN - AAAANN	For fitting, weld, etc.
				Reference electric enclosure and/or part [Sec. D7]	PPPPPP - TTT - NNNN - A[A][A]NN	Small switch in a cubicle, etc.
				Reference wall opening and penetration [Sec. D8]	PPPPPP - TW - NNNN - S LNN	For pipe sleeves within a wall opening
				Pre-Assignment Field [Sec. D4]	e.g. PP__PP-TTT-____ (* This is not ID-code)	Temporary description to be fulfilled after the installation.
Item Type Reference	PNI (Part Number of ITER [Sec. 6.2])	I XXXXXXXXX	Primary key ID-code on a Type Reference of individual item.	MN (Manufacturer Part Number) [Sec. D9]	Supplier to decide	Any part or product shall be designated with MN.
				Commodity Code [Para. D10]	SPMAT default code for item family	Mainly for Smart Plant
				Type code for pipe, valve, etc.	User to decide	As necessary
				Function Category Code, TTT [Sec. G]	TTT	[2FJMPY], [43WDW9]
Physical Item	SN (Serial Number) [Sec. 6.3]	Manufacturer / Supplier to decide	ID-code on physically realized item. If it is unique, SN is used. If multiple, lot num., etc. are used.	Lot (or batch) number [Sec. D11]	Supplier to decide	Produced as a group of items
				Heat number	Supplier to decide	Metallic item melt at once

Index numbers to be added to some ID-codes above:

- Trial fit index [Sec. D3] <Example of ID-code> -FIT-**X**
- Interface Locator index [Sec. D5] <Example of ID-code> -**XN**
- Nozzle Index [Para. D6.3] <Example of ID-code> -**XX**

(Regarding the digits, respect the main context)